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ACCOMMODATION *

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MECHANISM OF ACCOMMODATION; THEORY OF HELMHOLTZ

Of the facts concerned in the act of accommodation, two have been established beyond any reasonable doubt. One is that the increase in refracting power of the eye required in order to produce accommodation is effected solely by an increased convexity of the lens. The other is that this increased convexity itself is brought about by a contraction of the ciliary muscle.

There is not, however, absolute agreement as to the way in which contraction of the ciliary muscle makes the lens more convex. The prevailing theory, substantiated by many observations and ingenious experiments, is that of Helmholtz. This theory, briefly, is as follows:

The lens, owing to the elasticity of its capsule,[1] tends constantly to assume a spherical shape. It is prevented from doing this by the zonula, which is inserted on its two surfaces and runs thence outward and backward to be attached to the ciliary body, and through this to the choroid.

The zonula thus acts like a band connected with two springs—the one, anterior and more centrally situated, represented by the elastic expansion of the lens, the other, posterior and more peripheral, represented by the elastic traction of the choroid (Gullstrand). It is evident that the latter force is the greater, since when the accommodation is at rest the zonula is pulled back taut and the lens is flattened; in other words, the anterior spring is stretched and the posterior spring is contracted.

† Dr. Alexander Duane died on June 10, 1926.

* Mrs. Alexander Duane has courteously permitted the publication of certain chapters from the book on "Ocular Muscles," on which Dr. Alexander Duane was so industriously working, and had nearly completed at the time of his unfortunate end. These chapters represent the views of an authority who devoted his life to scientific research in a field to which he had so ably contributed.—THE EDITORS.

1. "The elasticity of the lens is mainly due to its capsular membrane for if the capsule is stripped off, the superficial layers of the lens show a mucous, rather than a gelatinous consistence. It makes no effort to maintain its shape against an exterior force or to return to its former shape when that shape has been altered. But that the lens when enveloped in its capsule is elastic and that the tension of the zonula suffices to produce visible changes of shape can be seen in the eyes of men or animals, not too long dead, if the lens and zonula are exposed from in front and traction is made with two fine forceps that grasp the lens on opposite sides. The lens is then seen to elongate in the direction of the traction and return to its curved shape, as soon as the traction lets up" (Helmholtz: Handbuch der physiologischen Optik., ed. 2, Leipzig, L. Voss, 1886, p. 136.

When, however, the ciliary muscle contracts, it pulls against the resisting choroid (hence the old name for the muscle of tensor chorioideae) and thus draws the zonula forward and tends to slacken it. The elastic lens, now able to expand, becomes more convex. As it does so, it remains closely applied to the zonula so as to keep it stretched. This is so until the lens reaches its limit of expansion. Thereafter if the ciliary muscle continues to contract so as to pull the zonula forward still more, the zonula, no longer put on the stretch by the expanding lens, becomes slack. The lens, thus losing some of the support of the zonula, sags down somewhat and even wabbles a little.

It is supposed that the circular fibers of the ciliary muscle are the chief agent in accommodation. When these contract they draw the circle formed by the ciliary processes toward the lens and thus slacken the zonula. The longitudinal fibers of the ciliary muscle, it is believed, draw the flat portion of the ciliary body and the choroid attached to it forward, and thus help in relaxing the fibers of the zonula which lie on the surface of these structures.

DIFFICULTIES IN THE HELMHOLTZ THEORY; OTHER HYPOTHESES

Several of the things demanded by the theory have apparently been confirmed by experiment. Thus it seems to be proved that the zonula is relaxed and the choroid is drawn forward in the act of accommodation (Hensen and Völckers[2]); Hess has apparently demonstrated that in extreme accommodation the lens does sag as the theory demands. The researches of Gullstrand seem to afford further proof of the validity of the theory, which accordingly has met with almost universal acceptance. Nevertheless, it presents certain difficulties that are hard to explain. For example, as Henderson[3] pointed out, it is difficult on mechanical principles to see how the zonula, which as it lines the ciliary body runs in a curve and not in a straight line, can act as an intermediary between the opposing forces of the lens and the choroid, respectively. This would seem possible only if the zonula ran straight between the two. Accordingly, while he admitted that the annular fibers of the ciliary muscle do, indeed, by their contraction act to relax the zonula by approximating the ciliary body to the lens, the radial fibers of this muscle act as opponents and tighten the zonula. In other words, in accommodation for near points (positive accommodation) the circular fibers (sphincter ciliaris) contract and the radial fibers relax; in changing accommodation from near to distance (negative accommodation), the reverse occurs. The longitudinal fibers, according to Henderson's view, act as a sustentaculum zonulae, preventing any strain from being transmitted to either the choroid or the retina.

Tscherning believes that accommodation is effected by a tightening and not a relaxation of the zonula. In other words, the contraction of the ciliary muscle makes the zonula tense so that it presses on and flattens the equatorial portion of the lens. This flattening of the lens at its equator must be compensated for by a dilatation at its center, and it is this dilatation that produces the bulging of the anterior surface of the lens at its center, which constitutes the essential feature of accommodation.

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2. Cited by Helmholtz (footnote 1).
3. Henderson: Ophthalmoscope **10**:520 (Sept.) 1912.

Stilling, opposing both Helmholtz and Tscherning, believes that the zonula plays but a subordinate part in accommodation. Agreeing with Tscherning, he says that even complete diversion of the zonula is insufficient to cause such a convexity of the lens as would account for accommodation. Much less, then, would a simple relaxation of the zonula effect this. Since, moreover, when the zonula is divided the lens does not fall away but still remains attached to the vitreous, he thinks that Hess' experiments do not prove the sagging of the lens that he deduces from them. His view of the accommodation is that it is produced essentially by a narrowing of the anterior ring of vitreous in which the lens is attached like a diamond in its setting. This contraction, effected by the action of the ciliary muscle, squeezes the lens together equatorially and makes it bulge forward and backward. The purely mechanical tension of the zonula regulates this process so that the action is not too great or irregular.[4]

Not very dissimilar is the theory of Lindsay Johnson.[5] According to him, the fluid in the circumlental space plays the part ascribed by Stilling to the vitreous. That is, the contraction of the ciliary muscle forces the ciliary processes in toward the lens. The incompressible liquid in the circumlental space is thus subjected to pressure which it transmits to the lens, squeezing that body equatorially and making its anterior surface bulge forward. The defect in the hypothesis, in my opinion, is that for the process suggested to be effectual the zonula would have to be absolutely rigid and absolutely impermeable.

It will thus be seen that while the fundamental facts on which the Helmholtz theory is founded are admitted by all, some place a different interpretation on these facts. The weight of experimental evidence seems to favor the Helmholtz interpretation. Yet there are those who believe that the evidence is not incompatible with a different explanation, and there are certain facts, especially those connected with the progress of presbyopia, which it is difficult to account for by the Helmholtz theory, and which will be presented in the ensuing section.

One point, which is often lost sight of, should be emphasized. According to the Helmholtz theory, no force is exerted on the lens itself, which expands in quite a passive way as soon as the zonula is relaxed. The lens, through changes in its constitution, may become more and more resistant to expansion, but this increased resistance imposes no added burden on the ciliary muscle. All that this has to do is to relax the zonula, and the zonula can relax as readily when the lens is rigid as when it is soft. It is well to emphasize this point, since even those who fully accept the Helmholtz theory speak as if lenticular sclerosis imposed an obstacle to ciliary contraction. According to the Helmholtz theory, it does not. According to other theories (Tscherning's and Stilling's), it does. The bearing of these differences in the point of view on the actual behavior of the accommodation in presbyopia will be commented on later.

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4. Stilling: Ztschr. f. Augenh. **25**:15 (Jan.) 1911; trans. by Butler, T. H., Ophthalmoscope **10**:519 (Sept.) 1912.

5. Johnson, Lindsay: New Theory of Accommodation, Arch. Ophth. **53**: 426 (Sept.) 1924.

LANCASTER'S EXPERIMENTS DEMONSTRATING CILIARY CONTRACTURE

Lancaster [6] has shown that the result of continued accommodative effort, kept up with an object at or within the near point, is to increase still further the accommodative effect; i. e., it brings both far and near points closer to the eye. The lens thus must assume an extra convexity beyond that which it has at its usual near point. This is analogous to the extra accommodation regularly produced when both eyes are used together, and the fact that it lasts for some time after the effort ceases is ascribed by Lancaster with great probability to a contracture of the ciliary muscle.[7] The important clinical bearings of this action, which are pointed out by Lancaster, will be referred to later.

WHY PRESBYOPIA DEVELOPS

The failure in accommodation developing progressively as time goes on is evidently due to the fact that in the later years the lens is unable to change its shape as it once did. An inability like this—progressive in all cases and irremediable when established—is naturally attributed to changes taking place gradually in the lens itself. It is known, as a matter of fact, that such changes, viz., increasing sclerosis of the lens substance accompanying a steady enlargement of the nucleus, do occur in all eyes. Accordingly, the almost irresistible and well nigh universal belief is that the diminution of the accomodation in age is due to these lenticular changes.

Simple and apparently adequate as this explanation seems, it presents some difficulties. Particularly does it seem unsatisfactory if one accepts

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6. Lancaster, W. B., and Williams, E. R.: Tr. Am. Acad. Ophth., 1914, p. 170.

7. Lancaster expressed the belief that when the ordinary near point has been reached, the ciliary muscle can produce no further effect on it. Hence the further convexity produced in the crystalline lens he attributed to a viscosity of the lens. To quote his own words: "This property of a body of showing changes in its shape under the influence of a *stress applied to it* is called viscosity. . . . Undoubtedly the lens has a certain viscosity, as a result of which the changes it undergoes in its shape *when acted on by forces applied to it* from without or within, do not occur instantly . . . but rather, as the force continues to act, the lens continues slowly to change its shape." (The italics in the quotation are mine.) This seems to me to be a confusion of thought. According to the Helmholtz hypothesis which he adopts, there is no stress put on the lens by the ciliary muscle, and there is no force acting and continuing to act on it. The language he uses is compatible only with Tscherning's or some similar theory, which regards accommodation as due to an impressed force and not to a relaxation. Leaving the question of these theories aside, it seems to me that a much more satisfactory explanation is that at the ordinary near point, the limit of action of the ciliary muscle on the lens (or, according to Helmholtz, on the zonula) has not yet been reached and that further expansion of the lens under the effect of an extra ciliary contraction is still possible.

the Helmholtz theory. For, according to this theory, accommodation consists in a bulging of the lens due to a relaxation of the zonula, which allows the lens to expand of its own elasticity. But Helmholtz says that the elasticity of the lens resides in the capsule alone. So long then as the capsule is intact and there is any considerable amount of displaceable substance surrounding the nucleus of the lens, it would seem as if the lens ought to be able to change its shape as fully as ever, since the plastic mass surrounding the nucleus would still adapt itself to the increasing convexity of the capsule when the latter was left free to expand. The lens may be compared to a rubber bladder stuffed tightly with a soft yielding substance and flattened down by a tight strap. In youth the yielding mass contains a small unyielding core which as years go on gradually enlarges. Not till this core became large would the expansibility of the wall of the bladder be interfered with. On this analogy no change should occur in the expansile power of the human lens until late in life, certainly not till after the age of 30. As a matter of fact, accommodation begins to diminish by 8 or certainly by 10 years of age. This seems inexplicable on the hypothesis of a passive dilatation, conditioned on an elasticity resident in the capsule alone. It is true that the elasticity of the capsule itself may diminish progressively with age, but it is hard to see how it could do so to such an extent between the ages of 10 and 20 as to reduce the accommodation a number of diopters.

The phenomena of presbyopia are, in fact, much more easy to understand if one admits that accommodation is effected not by a passive dilatation of the lens due to the elasticity of its capsule, but to a direct stress applied to the lens from without. For then any increase in the resistance of the lens would create opposition to the external stress and thus would interfere with the lenticular expansion. In this view the alternative hypotheses would seem more reasonable than that of Helmholtz.

There is, however, a third possibility which, except in a few quarters, has received but little consideration, and that is that the progressive diminution in accommodation is due in part at least to progressive diminution in the power of the ciliary muscle. I shall now consider this possibility.

RELATION BETWEEN CILIARY POWER AND LENTICULAR EXPANSION; PHYSICAL AND PHYSIOLOGIC ACCOMMODATION

The expansion of the lens giving it the increased convexity needed for accommodation is dependent on two factors: the physical constitution of the lens itself and the strength of the ciliary muscle. So long as the lens is kept compressed by the zonula, it cannot expand, no matter how fluid or elastic, if the ciliary muscle is powerless. There is in that case no accommodative action. This, in fact, is seen when the ciliary muscle is paralyzed from any cause. Again, even if the ciliary muscle acts per-

fectly, there can be no accommodative action if the lens is rendered absolutely rigid or has already expanded to its full capacity. Incapacity for expansion may be produced, then, in two ways: by lenticular or by ciliary inactivity. Moreover, incapacity from either cause—failure of ciliary contractility or failure of lenticular expansile power—may be incomplete, the accommodative power being not absent, but simply diminished. Defects of both kinds with this consequence are often seen clinically.

The two factors, lenticular expansibility and ciliary contractile power, are by no means equal, nor are they even necessarily correlative. Indeed, the common belief is that after the age of 15 they are very far apart. In any event, one may be sure that the ciliary factor is always in excess of the lenticular. The difference may be indicated in the following way. When the eye accommodates to its utmost so as to focus to a point p cm. from the eye, the amount of physical effect produced is indicated by the equivalent number of diopters, P. In this case $P = \frac{100}{p}$. Corresponding to each diopter of physical effect there is expended a unit—in all probably equal for each diopter—of ciliary energy, which unit may be called a myodiopter (Van Der Hoeve and others). The number, M, of such units or myodiopters that the ciliary body has at its disposal is always greater than P. Accordingly, when the eye focuses down to the nearest possible point, p, it need exert only P diopters of effort to effect this, and there remain M-P myodiopters, which are not exerted and remain latent. P in this case denotes what Fuchs aptly calls the physical accommodation; measuring the physical near point, p, and M denotes the physiologic accommodation. If the lens were absolutely elastic and the ciliary muscle could put forth its entire quota of energy, then, instead of the eye being focused to $p = \frac{100}{p}$, it would be focused down to the nearer point $m = \frac{100}{M}$. m in this case would be the physiologic near point.

ACCORDING TO THE HELMHOLTZ THEORY, THE TOTAL CILIARY ENERGY MUST DIMINISH WITH AGE

It is probable that the amount of physiologic accommodation actually exerted is in some cases greater than the physical accommodation, so that the latent accommodation is rather less than M-P. Thus, if a presbyope having only 1 diopter of accommodation has on a 3 diopter convex lens that enables him to read at 25 cm., it is likely that he uses for focusing on this point 4 diopters of ciliary energy, even though 3 diopters of this produces no effect on the lens (Fuchs). That is, he accommodates according to his convergence rather than according to his visual needs, for which the putting forth of 1 diopter of ciliary energy would suffice. Such cases apart, however, it is not likely that the disparity between the available physical accommodation (P) and the number of myodiopters (M) of ciliary energy actually exerted is ever very great.

If this is so, according to the Helmholtz theory as usually interpreted, the amount of latent and hence useless ciliary energy grows very great as age goes on.

Thus a boy, aged 10, may have 18 diopters of accommodation manifest. This, according to Hess and other advocates of the Helmholtz theory, would mean that he had perhaps 4 diopters of ciliary energy held in reserve. When the boy reaches the age of 20, his manifest accommodation has been reduced to 10 diopters, and there will then be 12 diopters of latent ciliary energy. So at 30, when the physical accommodation falls to 8 diopters, there will be 14 diopters; at 40 there will be 16 diopters and at 45, 18 diopters of ciliary energy unemployed and unserviceable.

There is very strong experimental and clinical evidence against this view.

1. In the first place, such a theory would mean that in persons of 25 and over, or certainly in those of 30 or over, there should be no fluctuation in accommodative power. To illustrate this I shall consider three subjects, aged respectively 10, 32 and 45. Each by hypothesis has at his disposal at least 18 and perhaps 20 diopters of ciliary energy (from 18 to 20 myodiopters). The boy of 10, when urged to the utmost effort, is able to use 16 or 17 of these 18 diopters and has, therefore, but 2 or 3 diopters latent. The man of 32 can at his utmost exert 9 diopters of accommodation and so has at least 9 diopters latent; and the man of 45 can exert only 3 or 4 diopters and thus has 15 diopters latent. The boy, then, when using 16 diopters of accommodation is working near the limit of his muscular power, and it can readily be understood that at times he might not be able to do nearly as well as this. And, in fact, the variations shown by these young subjects are at times considerable, amounting to 6 or 7 diopters. As a rule, however, they are much less, being only 2 or 3 diopters at the most. Indeed, the tests made in children of from 9 to 12 years of age are often surprisingly constant. In the child of from 9 to 12, the manifest accommodation, even when at the lowest limit of its variation, practically never falls below 9 diopters and very rarely, indeed, below 10 diopters. This amount of ciliary energy, then, he can exert at all times. One would expect the same to be true of the adult if he had the same amount of ciliary energy to draw on as the child. Hence, if the man of 32 really has 18 diopters of ciliary energy, but owing to the diminished elasticity of his lens can use only 9 diopters of this, he ought to have no difficulty in reaching this limit at all times since it represents only 50 per cent of his total energy. Of course, this argument is still more convincing if one supposes the total ciliary energy to be more than 18 diopters. There is no more reason why his accommodation should ever fall below the 9 diopters which his rigid lens permits him to use than there is for the boy to do likewise, since both have the same total to draw on. This is still more the case with the man of 45. The 3 or 4

diopters of ciliary energy which the latter is able to exert is such a small proportion of his assumed total of 18 or 20 diopters that it seems inconceivable that he should not at all times be able to put it into play. In neither the man of 32 nor the man of 45 should there ever be an inability to accommodate to the manifest maximum.

But, as a matter of fact, such inability is often seen; and one finds that the accommodative power in these middle aged subjects fluctuates rather considerably from time to time. Thus in a man of 32 whom I tested, the accommodation varied from 7.8 to 9.75 diopters, in another from 6.7 to 8 diopters, etc. In fact, at this age variations of a diopter or more are not infrequent. At 45 the variations are naturally much smaller, but they do occur and sometimes amount to nearly a diopter and even more. Thus, in one woman, aged 45, the accommodation in the course of three months ranged from 2.25 to 3.6 diopters. It seems inconceivable, that if this woman had 18 diopters of energy to draw on, she could not at all times have exerted without any trouble the full 36 diopters that her rigid lens permitted her to use.

2. If there is so much accommodation in reserve, it seems inconceivable that a subject who when tested in one way showed a given maximum should be able to increase that maximum by any artifice.

But this can be done, For example, a subject, whose maximum power tested by repeated trials, if either eye alone was used, was 2.5 diopters, showed when tested with both eyes together, an accommodation of 3.6 diopters. This extra diopter of accommodation was evidently secured by an overplus of ciliary effort, not exerted under ordinary conditions, but put forth under the influence of convergence.[8] As has already been pointed out, this increase of accommodative power as a result of convergence in binocular vision occurs regularly in subjects of all ages. The inference would seem to be that in a case like this the total accommodative energy which the state of the lens would permit to be put into use was 3.6 diopters, but that under ordinary conditions even this small amount could not be exerted even when the patient was making an extreme effort. This inability seems inexplicable, if there is really a total of 18 diopters to draw on.

3. The most convincing evidence, however, is afforded by the study of the effect of cycloplegics, especially homatropine. Here is a drug that produces a gradual paresis of the ciliary muscle—a paresis that takes usually an hour or more to become complete. Suppose now that one has

8. The argument that the increase of accommodation in binocular vision is apparent only, being due to the sharper definition produced by the contraction of the pupils that the convergence causes, is negatived by the fact that in this case, as in numerous others studied, the convergence was so moderate that there was no sensible contraction of the pupils.

four subjects, aged respectively 10, 20, 30 and 40, into whose eyes homatropine is instilled. The first of these subjects has perhaps a manifest accommodation of 16 diopters, the second 11 diopters, the third 8 diopters and the last 5 diopters. In all four cases, according to hypothesis, there are at least 18 diopters of ciliary energy (18 myodiopters). In the first case, then, there are 2 diopters of accommodation latent, in the second 7 diopters, in the third 10 diopters or more, and in the fourth not less than 13 diopters. In the first, then, the drug should act quickly since its effects would become manifest as soon as it had abolished 2 diopters of the total accommodation. In the second case, the effect should take longer to become apparent, since the drug has first to abolish 7 diopters of latent ciliary accommodation. Still more slowly should the drug act in the third case, that of the man of 30, and slowest of all in the fourth case, that of the man of 40.

As a matter of fact, the drug acts as a rule more quickly in the man of 30 than it does in the boy of 10 or the youth of 20; and in the man of 40 it acts more quickly than in any one of the three younger subjects. The validity of this statement is attested to by statistics based on the examination of more than 2,000 cases in which I carefully measured the progress of the cycloplegia produced by homatropine.

All of the foregoing facts seem inexplicable on the supposition that the ciliary muscle maintains its power substantially unchanged through youth and middle age and yet acts in the way the Helmholtz theory demands. But they are easily explicable if one supposes that the ciliary energy diminishes with age almost in proportion as the manifest accommodation diminishes. If, for example, a man of 40 with a manifest accommodation of 6 diopters has a total ciliary energy of 8 and not of 18 diopters, it is readily seen why his manifest accommodation may fluctuate a diopter or so, and also why under the influence of homatropine it shows a reduction at least as early as in the case of a younger subject with a much higher accommodation.

The same conclusion is borne out by a study of the curves representing the fall of the accommodation produced by homatropine at different ages. Thus, of 220 patients between 41 and 45 years of age, I found that in 154 the accommodation had already begun to recede in twelve minutes. By this time, as the curves and the tabular records show, it had fallen to an amount varying generally from 2 to 4 diopters. This amount represented the whole of their ciliary energy then remaining. For the fact that they were now persistently below their starting point, which represented the limit set by their sclerosed lenses and that they could not by any effort attain this limit, again shows beyond doubt that all their latent accommodation and some of their manifest accommodation, too, had been abolished. Accordingly, if one supposes that these subjects really had 18 diopters of ciliary energy to

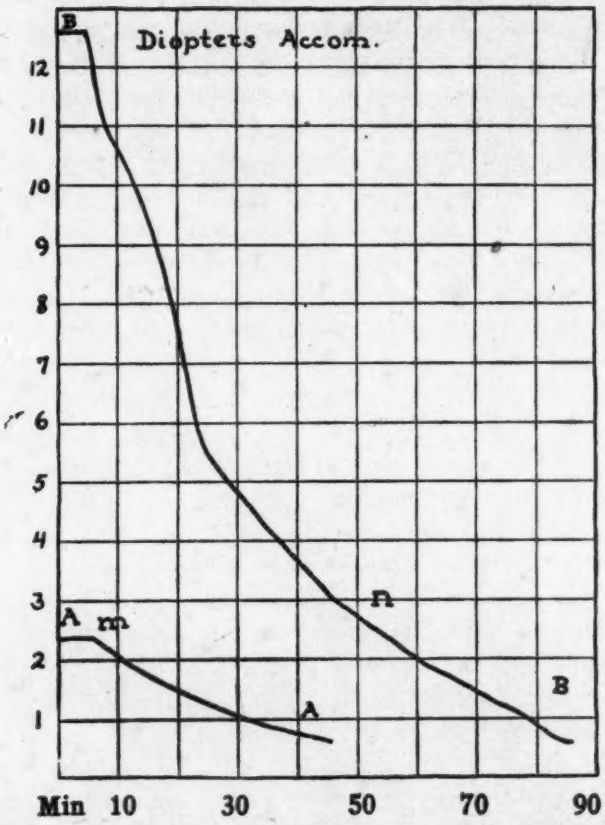

Chart 1.—*A,A,* curve representing the recession of the accommodation under homatropine in a man of 45. *B,B,* similar curve in a girl of 12. If the original accommodation in each case is supposed to be 18 diopters, the fall in six minutes in the first case would be 15.6 diopters, or 78 per cent, while the fall in the second case would be 6 diopters, or 33 per cent. But if the original accommodation in the first case is supposed to be 3 diopters, and in the second case 15 diopters, each curve really would be alike, representing a fall in a geometric ratio of 20 per cent each six minutes—i. e., at the end of each six minute period the residual accommodation would be 80 per cent of what it was at the beginning of the period. This more plausible assumption seems borne out by the following fact. Curve *A* from *m* onward is almost precisely like curve *B* from *n* onward. One may reasonably infer that the small portion of curve *A* before *m* (representing in this case the diminution in the latent accommodation) and an equally small portion of curve *B* before *n* are also alike. In this case the starting point of curve *A* would be somewhere about 3 diopters.

start with, they must have lost from 14 to 16 diopters in twelve minutes. The curves show that the amount a young subject loses in twelve minutes is at its greatest 9.5 diopters, but usually does not exceed 6 diopters, and not often 4 diopters. It seems inconceivable that an older subject should regularly lose an amount so much greater in the same time.

It seems inconceivable, too, that the amount of accommodation abolished in a given time by the action of homatropine should regularly increase with age. But this is what it does do, if the theory is correct. Thus in four subjects, aged 11, 20, 31 and 40, respectively, the curves showed that if the original ciliary energy was assumed to be 18 diopters, in the first case the reduction produced in fourteen minutes was 28 per cent, in the second 41 per cent, in the third 60 per cent and in the fourth 82 per cent. Such an excessive difference seems unlikely. Much more probable is it that the rate of fall in accommodation due to the homatropine is more nearly equal in the four cases. In this event the original supply of ciliary energy, which is probably 20 diopters or more in the first case, must be distinctly lower in the second, lower still in the third and lowest of all in the fourth.

Different curves indicate by their form that the rate of recession under homatropine may differ considerably in different cases. Again, many of the variations are such as to make one believe that the original stock of ciliary energy may differ a good deal in persons of the same age. But all the curves examined lead to the same inference, i. e., that as age advances the total of ciliary energy diminishes, and that in middle age there is a very small stock to draw on. Thus in chart 1, the curve *A*, which represents the recession in one of my patients, aged 45, shows that the accommodation, 2.4 diopters to start with, had already begun to fall in seven minutes. One cannot believe that in such a space of time it could have undergone a drop of 15.5 diopters or of 86 per cent, as the hypothesis would demand. Rather it seems likely that the real stock of ciliary energy originally present was not over 4 diopters, probably a little less. Then the drop in successive periods of time would correspond quite closely to those shown in curve *B*, taken from a girl, aged 12 years.

Thus, if one supposes the latter to have had 18 diopters of original energy to draw on, while the man of 45 had but 3.5 diopters, the fall in the first ten minutes in each would be about 40 per cent, in twenty minutes between 50 and 60 per cent and in thirty minutes between 70 and 75 per cent. There seems no valid reason why this should not be true, i. e., why the accommodation should not drop by approximately equal ratios in both. That the original stock of ciliary energy in the case represented in curve *A* is only 3.5 diopters seems also likely from the striking correspondence between curve *A* and the last part of curve *B*.

That is, if the progress from the point *m* onward in curve *A* is like that from *n* onward in curve *B*, it seems likely that the progress in the small portion just before *m* and *n* is also alike. If this is so the starting point in the case of curve *A* would not be over 3 diopters.

Curve *A* is not unusual but typical. One may infer from it and from others taken at different ages that the amount of latent accommodation, i. e., the difference between the total and the manifest ciliary energy, does not increase rapidly with age, as has been thought. On the contrary, it either remains of the same moderate amount during life or, more likely, diminishes as the years go on. For the fact that the recession of accommodation under homatropine regularly occurs earlier in the older subjects indicates rather clearly that in them the absolute amount of latent accommodation is less than in the young.

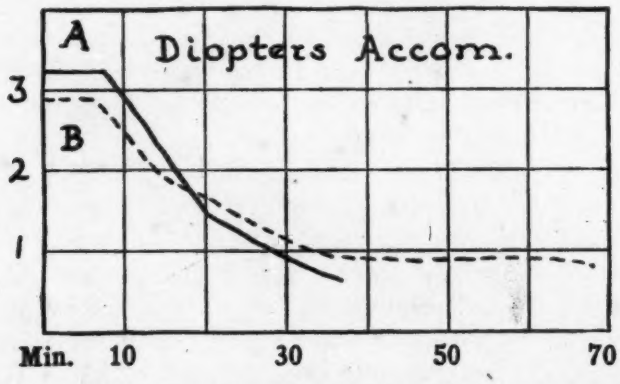

Chart 2.—*A*, curve representing the recession of the accommodation under homatropine in a woman of 45, with an accommodation normal for her age. *B*, similar curve in the case of a boy of 20, with an excessively subnormal accommodation. Note the marked similarity, indicating that the physiologic reduction in the one case caused by age is paralleled by the reduction in the other case caused by disease. If the original stock of accommodation (ciliary energy) in the first case was 18 diopters, it must have fallen 14.8 diopters, or 82 per cent, in seven minutes. It is much more likely that this original stock was really only 8 diopters, in which case curve *B* would represent precisely a recession in a geometric ratio of 25 per cent every six minutes.

As corroborative evidence may be cited the fact illustrated in chart 2, that the curve showing the recession of accommodation under homatropine was essentially the same in a man of 20 with a pathologically subnormal accommodation, and in a woman of 45 with the accommodation reduced normally by age. In both, the recession began at about the same time, the amount of manifest accommodation before recession began was not essentially different and the fall was alike in both. The inference seems fair that the fall in amount of latent ciliary power was also about the same in the two, so that the total ciliary power in the two

cases was practically equal. This would mean that the ciliary muscle had its power actually diminished in the one case by age, as in the other case it was certainly diminished by some morbid process.

BEARING OF OBSERVED FACTS ON THE DIFFERENT THEORIES OF ACCOMMODATION

The foregoing facts and considerations seem to me to lead to the following conclusions:

1. If one accepts the Helmholtz theory, one must admit that the total ciliary energy, instead of being from 18 to 20 diopters or more at all ages, probably varies not a little in the different subjects at the same age, and in the same subject undergoes a steady reduction year after year, just as in the case of the manifest accommodation. In fact, according to this hypothesis, the difference between the total ciliary energy and the extreme (i. e., binocular) manifest accommodation—which difference constitutes the latent, or unused ciliary energy—instead of growing greater as age advances, either remains the same or more probably grows progressively less and less. The curves indicate that this difference, amounting to 4 or 5 diopters in younger subjects, is probably only 1 or 2 diopters in the middle aged. This would mean that the total energy of the ciliary muscle, which in childhood may be denoted as from 16 to 20 diopters, falls at 20 to from 12 to 15 diopters; at 30 to from 10 to 13 diopters; at 40 to from 7 to 10 diopters; at 45 to from 4 to 7 diopters, and at 50 to from 3 to 5 diopters.

2. If, however, one accepts the theory of Tscherning or some other hypothesis which ascribes the lenticular changes in accommodation to external stress applied directly to the lens, the facts may bear a different interpretation. It is conceivable—indeed probable—that such stress to produce an effect represented by 3 diopters of accommodation would have to be considerably greater in the case of a sclerosed and resisting lens than in that of a fluid lens. That is, a physical accommodation of 3 diopters in the middle aged adult would represent a physiologic effect greater and greater as the sclerosing process advanced, i. e., as age increased. In the middle aged adult it might well represent a physiologic accommodation of from 10 to 12 diopters. If this is the case, it is easy to see how all the facts given in the varying accommodation and the speedy action of homatropine in middle life are compatible with the assumption that the total sum of ciliary energy, instead of decreasing from youth up, as seems necessary if the Helmholtz theory is adopted, either remains the same or, more probably, actually increases during adolescence, to decrease later moderately, if at all.

3. There is a third possibility, viz., that both processes—diminution of the ciliary energy and increase of the lenticular resistance or inelas-

ticity—may cooperate to produce the steady reduction in the accommodative power.

4. The evidence of physiologic optics is strongly in favor of the Helmholtz hypothesis; the evidence of physiology and anatomy and of clinical observations seems rather to point to one of the theories which ascribes the lenticular expansion occurring in accommodation to force applied directly to the lens itself.

COMPLETE BILATERAL CONGENITAL EXTERIOR OPHTHALMOPLEGIA AND DOUBLE PTOSIS

BILATERAL CEREBRAL CORTICAL ATROPHY OF FRONTAL AND PARIETAL REGIONS (ENCEPHALOGRAMS): A CLINICAL COMMUNICATION *

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This communication concerns itself with the case history of a patient whose chief permanent morbid manifestations are described in the title, who suffered for long periods of time from violent headache and vertigo, and who was the subject of various temporary disturbances, presumably functional.

Except as mentioned incidentally, varieties of exterior ophthalmoplegia other than those which are complete and congenital are excluded from this discussion. The important literature on this subject, thus limited, is reviewed.

REPORT OF CASE

History.—M. S. P., an American woman, unmarried, aged 44, holding an executive position in an orphan asylum, reported for examination on Oct. 7, 1929. She sought relief from a violent headache and hoped that a recorrection of her high refractive error would improve her visual acuteness, which had been gradually diminishing for the past four years.

She was admitted to the hospital of the University of Pennsylvania on October 17, where the neurologic examinations were conducted by Dr. William G. Spiller [1] and the members of his staff, and the ocular investigations were continued by me and by Dr. Alexander Fewell.

The patient was born with complete bilateral ophthalmoplegia and double ptosis. Until her ninth year, when an operation on the ptosed lids was performed, she could see directly when the head was tilted backward in the characteristic position of ptosis.

During her entire life she had been subject to severe frontal headache, and four years before, a sharp stabbing pain began, at first deep in the left eye and one year later in a similar position in the right eye; this was increased by efforts at reading and by physical exertion, and it stubbornly resisted treatment.

In June, 1927, preceded by vertigo and a staggering gait, unconsciousness developed, the patient remaining in that state for three days, without convulsions. Vomiting ensued and vision was markedly diminished; the pain, previously localized in the frontal area, spread over the head into the occiput and the scalp became tender to the touch.

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* Read before the Section on Ophthalmology at the Eighty-First Annual Session of the American Medical Association, Detroit, June 27, 1930.

1. I am indebted to Dr. Spiller for the privilege of utilizing his notes of the various examinations made in his department of the University Hospital.

Since the original period of unconsciousness, in June, 1927, six similar "attacks" had occurred, varying in duration from a few hours to four days, and always preceded by intense dizziness and numbness, more pronounced on the right than on the left side of the body, and followed by vomiting.

For a considerable period of time the patient suffered intermittently from vertigo; for the past two years it had been practically continuous and was present even at night when she awakened from sleep.

Also, during the past three months, sudden periods of blindness had taken place, remaining from a few minutes to a quarter of an hour. They were unaccompanied by any alteration in ocular pain, headache or vertigo.

The patient reported that owing to progressive deterioration of vision she had not been able to read for two years, although she admitted that as part of her duties as matron of the institution where she was employed she prepared and wrote the required reports and records.

Although general weakness had long existed, local palsies had never been detected. In general terms, the patient had slept well and had not been especially nervous. Occasionally she had experienced precordial pain and dyspnea after exertion. Her appetite had always been poor and constipation stubborn. Appendectomy had been performed in 1908, and in 1915 an operation "on the large bowel." The urinary functions had been normal.

Menstruation was established at the age of 14, but did not develop again for a year; then it reappeared and continued, but with marked irregularity, until four years before, when the periods began to occur regularly each month. Recently menstruation had taken place twice during each four weeks; there was no bleeding between the periods.

During childhood the patient had had measles, whooping cough and chickenpox, and was said to have had an attack of spinal meningitis in 1918. Her father died at 58 and her mother at 78 from heart disease; one brother died of spinal meningitis; three sisters and three brothers were living and well. No eye trouble had appeared in any members of her family or among her forbears, as far as she was aware. She drank several cups of coffee a day, but no tea; she used neither tobacco nor alcohol.

General Examination.—The patient was thin, somewhat emaciated and asthenic, and weighed only 99 pounds (45 Kg.).

Her head, small but symmetrical, was tender on deep pressure; her thin neck revealed no abnormal pulsation; the thyroid gland was not enlarged; anterior cervical adenopathy was present on the right side. There were no evident abnormalities of the nose and ears, except that hearing on the left side was somewhat defective (the exact degree of the defectiveness was not recorded).[2]

All the teeth had been extracted, and the patient wore upper and lower plates; no tonsillar tissue could be detected. There were no indications of pulmonary disorder. The heart was slightly enlarged to the left, as revealed by percussion; there were no cardiac murmurs.

The abdomen was slightly rigid and tender to the touch; a scar marking the position of an operation (appendectomy) was visible on the right side of the median line above the symphysis; the percussion note was tympanitic, and peristalsis was normal.

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2. Dr. Homer H. Lewis informed me that during the past five or six years roentgen examinations made at various times at the Clearfield Hospital, Clearfield, Pa., revealed indications of infected sinuses, and occasionally a discharge from the ethmoid appeared.

The extremities were normal; the external genitalia were not examined.

Two examinations of the urine revealed an acid reaction but no albumin, sugar or casts, and only a few mucous shreds and epithelial cells; the specific gravity was 1.020.

The blood count was as follows: red blood cells, 4,600,000; white blood cells, 7,500; hemoglobin, 88 per cent; neutrophils, 71 per cent; lymphocytes, 23 per cent; large mononuclears, 3 per cent, and eosinophils, 3 per cent.[3]

Neurologic Examination.—There was no Romberg sign; all movements were associated with an apparently slight weakness of the right leg and arm, but the patient was generally weak and had a poorly developed musculature. There was no incoordination or adiadokokinesis; all reflexes were somewhat exaggerated, about equally on the two sides.

There was an absence of an appreciation of touch, pain, heat and cold over the left hand and arm to the elbow, over the right hand and arm to the shoulder, over both legs to Poupart's ligament, over the entire forehead and face to the mandible and over an irregular area in the back of the neck.

The patient did not distinguish odors; the sense of taste was normal, but the buccal mucous membrane was anesthetic; the tongue protruded in the middle line and its movements were normal; the head, shoulder and facial movements were all performed normally.

The patient was cooperative but apparently rather indifferent to her physical condition. Although she was not mentally alert, mentality was not in abeyance.[4]

Observation of an Attack of Unconsciousness.—The following observations were recorded by Drs. Thorpe and Gilbert, interns in the neurologic department of the hospital: In the late afternoon of October 19, two days after the patient's admission to the hospital, she began to complain of numbness below the knees, and anticipated an "attack." Shortly afterward, while eating her supper, she suddenly fell in to a deep sleep and could not be aroused.

The temperature was 98.4 F., the pulse rate 116, and respirations 24; the blood pressure was 165 systolic and 90 diastolic.

A fine fibrillary tremor was visible around the lower lip and extended outward on both sides of the face. The right hand was warm, the left cold. There was no response to pin pricks on any part of the body. Attempts to open the eyes forcibly were resisted. The knee jerks were exaggerated and bilateral patellar clonus was elicited; there was no ankle clonus. The plantar reflex on the right side was of the extension type, all toes, however, going into extension.

A dose of ammoniated tincture of valerian was administered; vomiting followed, and the patient immediately became conscious. Shortly afterward, she fell asleep quite normally.

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3. Dr. Lewis informed me that the patient's "blood count showed a moderate secondary anemia, but the blood chemistry, urinary analysis and kidney efficiency were always within normal limits, and the basal metabolism was also normal."

4. The record of the neurologic examination has been condensed from notes made by Dr. Irish of Dr. Spiller's staff. During a neurologic examination by another observer, it was recorded that the patient was "intelligent and cooperative;" that after walking a few steps, "staggering" ensued; that in testing for the Romberg sign, considerable "swaying" took place, apparently related to the intense vertigo which was constantly present; that here and there spots of hyperalgesia were detected; that a sense of the position of the fingers and toes was lost, and that astereognosis was present.

Ocular Examinations.—Vision of the right eye was 5/45 and of the left eye 5/45, the correcting lens over each eye being + 7 sphere + 2.50 cylinder, axis 90; no improvement resulted from any alteration in the lenses. The pupils were slightly unequal, measuring 3 and 3.5 mm.; the direct and indirect light reflexes of the pupils were normal. The contraction of the pupils which normally takes place when the visual axes converge on a near point could not be elicited because convergence power was entirely absent; a faint response during an effort at accommodation was detected.

The eyeballs were fixed; that is, not the slightest movement occurred during an effort to rotate them upward or downward, outward or inward or in oblique directions. The eyes were not prominent but were moderately divergent, the right one being slightly lower than the left.

Fig. 1.—*A*, congenital exterior ophthalmoplegia; two attempts had been made to correct the ptosis when the patient was a child. *B*, congenital exterior ophthalmoplegia, showing effect on the ptosis of strong contraction of the frontalis muscle.

There was double ptosis, which according to the history had been practically complete until the ninth year, when some operation, probably an excision of an elliptic portion of the skin of the lids, was performed; another one, doubtless of a similar nature, was performed when the patient was 23 years of age. The width of the right palpebral fissure was 4 mm., and that of the left 5 mm., being somewhat increased during forced frontalis effort (fig. 1).

The media were clear; the fundi exhibited no abnormalities of the disks, retinas or choroid.

The visual fields ($\frac{10}{300}$ mm. white test object) showed almost complete absence of the nasal fields and considerable contraction of the preserved areas, greater in the left field, suggesting somewhat an impure binasal hemianopia (fig. 2).

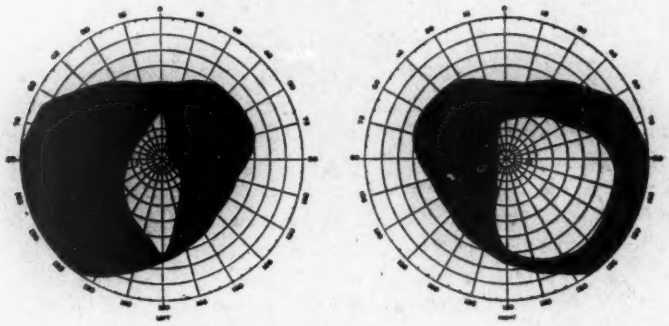

Fig. 2.—Left and right visual fields ($^{10}/_{300}$ mm. white test object), suggesting somewhat an impure binasal hemianopia.

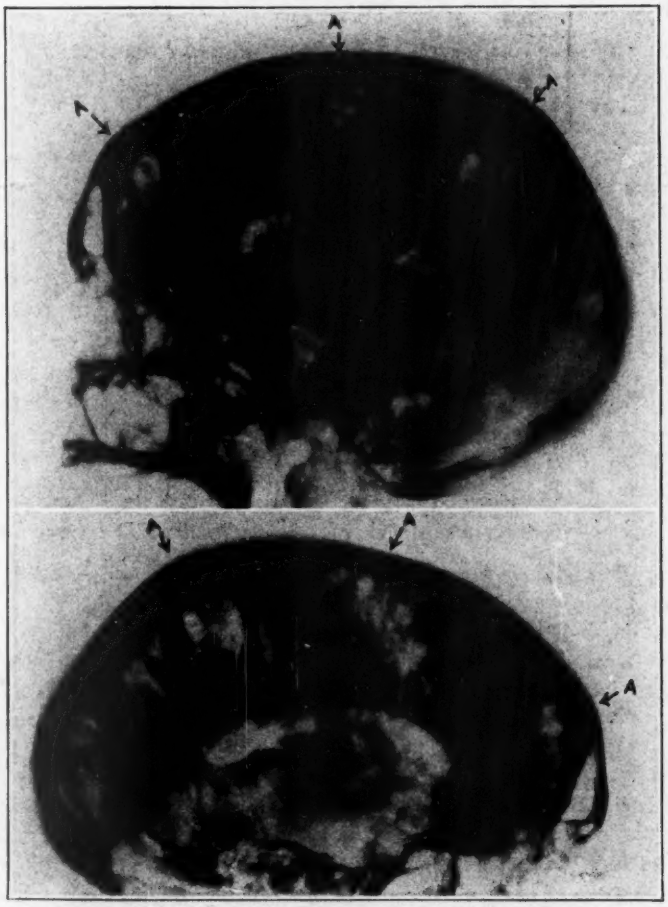

Fig. 3.—Encephalograms revealing enlargement of the subarachnoid spaces, which is regarded as evidence of atrophy of the brain in the frontoparietal area. The arrows indicate the right and left lateral views.

Special Examinations.—With the patient under ether anesthesia, lumbar puncture was performed on October 24. The fluid was clear and colorless. The Wassermann reaction and the colloidal gold curve were normal.[5]

An operation for an encephalogram was performed by Dr. Gardner of the Department of Neurosurgery. His notes are as follows: The initial pressure in the horizontal position was 190 mm. of water, which was considered to be normal in view of the fact that the patient required inhalation of ether in order to supplement the colonic anesthesia. The patient was next placed in the erect position in the encephalogram chair. Fluid was removed in 5 cc. amounts until a total of 150 cc. was obtained. The final pressure was 180 mm. of water; encephalographic studies were made and the following report was submitted by Dr. Pancoast:

Fig. 4.—Anteroposterior view of brain, indicated by arrows.

"The roentgenogram revealed bilateral cortical atrophy in the frontal and parietal region, indicated by large collections of air and widening of the subarachnoid spaces. There was increased prominence of the cisterna venae magnae cerebri. The lateral ventricles were normal and in the middle line. The third ventricle, the aqueduct of Sylvius and the fourth ventricle were normal. There was some calcification of the falx cerebri. The basal cisternae were normal (figs. 3 and 4)."

With especial reference to the "attacks" of unconsciousness, Dr. Spiller wrote: "Hysteria plays a large rôle in the symptoms of this patient. Extraordinary objective loss of sensation in the greater part of the body has been demonstrated. She has had at one time an area of complete anesthesia, which I have found

5. Prior to the patient's admission to the University Hospital, she had been in the Clearfield Hospital on several occasions; Dr. Lewis reported that the Wassermann and Kahn tests of the blood invariably gave normal results.

at a later date to be entirely normal in sensation. The marked variation in sensory conditions cannot be explained on any organic basis. There is certainly enough in this patient's history for a foundation for hysteria in association with organic disease."

Course.—After twelve days' residence in the hospital, the patient returned to her home (October 29), exhibiting little or no improvement with respect to vision or to the general symptoms that have been described.

Two weeks later, she wrote: "I feel so much better; I am not suffering from headache any more. I still have blind spells, but hope they will gradually go away." At the expiration of three weeks, she described additional improvement.

On Jan. 8, 1930, five weeks after she had left the hospital, the patient returned for additional investigation. The improvement in her general condition described in the letter quoted was evident. She was cheerful, entirely free from headache or pain of any description, had gained 9 pounds (4 Kg.) and had experienced no recurrence of "attacks of unconsciousness" or temporary amaurosis.

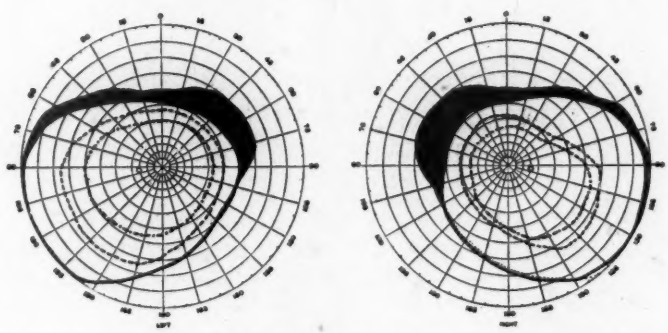

Fig. 5.—Left and right visual fields ($\frac{5}{300}$ mm. white test object, and $\frac{10}{300}$ mm. red and green test objects, the last two indicated, respectively, by a broken line and by dashes and dots). This chart may be compared with figure 2 to show the improvement that resulted after treatment.

Vision was 6/15 — in the right eye and 6/22 in the left eye, without change in the formula of the glasses with which the original test was made (+ 7 sphere + 2.50 cylinder, axis 90 over each eye); with + 2 diopters added to this correction, M = 0.75 at 20 cm. The visual fields for white ($\frac{5}{300}$ mm. test object) and red and green ($\frac{10}{300}$ mm. test object) were not far from normal in extent (fig. 5). These results were considerably different from those obtained at the first examination.

Naturally, the exterior ophthalmoplegia and ptosis remained unchanged, save only that in forced efforts to bring the elevators of the eyeballs into action a faint intorsion movement of the right globe was detected.

COMMENT

Bilateral exterior congenital ophthalmoplegias and double ptosis, that is, conditions in which the internal muscles are spared, and a few in which there is a familial hereditary basis, may be complete, or practically

so. An actual totality in this respect, however, is rare. Belonging to this exclusive group are cases reported by Tilley,[6] Grauer,[7] Schiler,[8] Heard,[9] Weisenburg,[10] Bradburne,[11] Gourfein,[12] Cary[13] and Aurand.[14]

Excluded from this group, if one adheres strictly to the term "complete," are those ophthalmoplegias in which "minimal excursions" are described, usually inward or outward, and they are definitely in the majority. T. M. Li's[15] report of two cases of congenital ophthalmoplegia is a good example of these "minimal excursions," in that there was slight inward and outward rotation; it is valuable also from another standpoint, as will presently appear.

In the right eye of the patient whose clinical history forms the basis of this paper, the second examination, as already noted, revealed a faint intorsion movement which had not been present at the original investigation or had not been detected; this hardly excludes the case from the "complete" list. Indeed, it is more than likely that in some of the cases referred to as "complete" a similar faint movement would probably have been discovered had the investigation been more exact.

Nystagmus is not uncommon; rotary (Pinard, Gourfein), horizontal (Aurand) and irregular (Lawford) movements and those excited by efforts at convergence (Grauer) are among the reported manifestations. Cary[13] assumed that the slight rotary movement of the eyeball which he noted in his patient was due to contraction of the orbicularis palpebrarum, because some of its fibers are attached to the medial palpebral ligament and the lateral palpebral raphe, which in turn

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6. Tilley, R.: Congenital Complete Paralysis of the Oculomotors, Am. J. Ophth. **2**:195, 1885.

7. Grauer: Ein Fall von Ophthalmoplegia exterior bilateralis congenita, Nord. Ophth. Tidsskr. **2**:15, 1889; cited by Kunn: Beitr. z. Augenh. **2**:51, 1895. (The original article is not available.)

8. Schiler: Angeborene Augenmuskellähmung, durch drei Generationen vererbt, Med. Cor.-Bl. d. württemb. ärztl. Landesver. **65**:26, 1895.

9. Heard, C. F.: Hereditary Binocular Ophthalmoplegia, Ophth. Rec. **10**: 404, 1901.

10. Weisenburg, T. H.: Hereditary External Ophthalmoplegia, J. Nerv. & Ment. Dis. **35**:268, 1908.

11. Bradburne, A. A.: Hereditary Ophthalmoplegia in Five Generations, Tr. Ophth. Soc. U. Kingdom **32**:142, 1912.

12. Gourfein, D.: Un cas de double ophtalmoplégie extérieure congénitale et héréditaire chez six membres de la même famille, Rev. méd. de la Suisse Rom. **16**:673, 1896.

13. Cary, E. H.: Total Ophthalmoplegia, Contributions to Ophthalmic Science, Jackson's Birthday Volume, Menasha, Wis., George Banta Publishing Company, 1926, p. 126.

14. Aurand, M.: Ophtalmoplégie externe congénitale bilatérale et familiale, Ann. d'ocul. **163**:272, 1926.

15. Li, T. M.: Congenital Total Bilateral Ophthalmoplegia, Am. J. Ophth. **6**:817, 1928.

are connected by the medial and lateral check ligaments through the fascia bulbi with the medial and lateral rectus muscles, and to some extent with the other ocular muscles.

The refraction of the eye in these cases, not always reported, indicates a slight preponderance in favor of myopia; twice emmetropia is recorded. In two instances the hyperopia was of high degree, being associated in one with a high degree of corneal astigmatism (Schiler's [8] case and my own). Usually the correction of the indicated error of refraction failed to yield normal direct vision, but normal visual acuteness was mentioned once or twice as being present without the aid of correcting lenses.

Generally the eyegrounds have not revealed pathologic changes. Twice optic nerve atrophy was described, but syphilis (inherited) was a probable etiologic factor, and the cases do not, it would seem, belong to this group.

Apparently few studies of the visual fields have been made, but two reporters (Gourfein and Uhthoff) recorded visual fields normal for white and colors.[16]

In this entire group, as strictly defined, the interior ocular muscles have not participated in the palsies.

PATHOLOGIC HISTOLOGY

It has been generally, although not universally, assumed that the cause of congenital ophthalmoplegia is concerned with defects or imperfect development of the nuclei of the nerve supply of the exterior ocular muscles.

It is true, however, as Oppenheim pointed out, that "few examinations have hitherto been made into the pathologic cause of this affection." So far as I am aware, there is no pathologic study of the nuclear areas in any case of complete exterior congenital ophthalmoplegia on record.

Bearing indirectly on this subject is the case reported by Langdon and Cadwalader [17] of chronic, progressive external ophthalmoplegia in a woman, aged 81, which began in her forty-third year and which, as far as they have been able to ascertain, is the only reported case in which necropsy was performed. They found definite changes in the

16. Caudron (Un cas d'ophtalmologie double, Rev. d'ophth. **6**:18, 1887) described marked changes in the field of vision, especially for colors, which were appreciated only in the lower nasal quadrant of the right field, and left central scotoma. His patient had optic nerve atrophy, however, with a history of hereditary syphilis, and does not belong to this group.

17. Langdon, H. M., and Cadwalader, W. B.: Chronic Progressive External Ophthalmoplegia, Brain **51**:321 (Oct.) 1928. (This article contains a review of the literature.)

nuclear areas as compared with control sections: a diminished number of cells and variations in their size and shape. This observation suggests that similar and even more extensive nuclear changes would be found in the various forms of congenital exterior ophthalmoplegia.

Moebius, whom Oppenheim [18] quoted, ascribed this condition to a defective development or actual absence of the nuclei (infantile nuclear atrophy). Huebner, also cited by Oppenheim, satisfied himself by a pathologic examination of the nuclear area of his patient (partial palsy, details not recorded) that the palsies were due to nuclear aplasia. Uhthoff assumed congenital deficiency in anlage of the ocular muscles in his patient with practically complete congenital exterior ophthalmoplegia.

It may well be that in some of these cases the nuclear aplasia is not complete; that is, a hypoplasia exists. There may be a defective formation, a congenital inferiority (Oppenheim) or an abiotrophy of the corresponding nuclear apparatus, which causes premature death or decay of the tissues (Gowers).

But another factor must be taken into consideration. As Spiller [19] pointed out, "undoubtedly, the chief lesions of ophthalmoplegia, either congenital or acquired, provided the acquired form has existed for a long time, are in connection with the nerve and muscle supply of the part affected."

Fuchs [20] studied five patients with bilateral ptosis of long standing as the only symptom of disease. He excised strips of the levator palpebrarum of one of these patients, which revealed atrophy and thinning of the fibers, an increase in the number of the nuclei and pigment degeneration in the sarcolemma.[21]

Gourfein [12] expressed the belief that there is no anatomic or pathologic proof of the nuclear or nervous origin of congenital exterior ophthalmoplegia; he assumed that the condition is purely muscular in origin—an assumption not based, however, on the results of autopsy. Heuck found atrophied and deformed muscles, and suggested that the condition is due to primary atrophy of the muscles. However, both he and Axenfeld (quoted by Oppenheim) found the muscle in congenital ophthalmoplegia (not complete) histologically intact.

Bradburne,[11] in a discussion of hereditary ophthalmoplegia in five generations, described three types; he maintained that the loss of ocular

18. Oppenheim: Textbook of Nervous Diseases, translated by Alexander Bruce, ed. 5, New York, G. E. Stechert & Co., 1911, vol. 2, p. 1041.

19. Spiller: Personal communication to the author.

20. Fuchs, E.: Ueber isolierte doppelseitige Ptosis, Arch. f. Ophth. **36**:234, 1890.

21. A discussion of these cases in their relation to chronic progressive bilateral ophthalmoplegia is given by Collins, E. T.: Tr. Ophth. Cong., Washington, 1922, p. 103.

motility in one of them was due to defects in the ocular muscles (complete absence or faulty insertion). Lawford [22] reached a similar conclusion.

Cary,[13] who attributed the complete exterior ophthalmoplegia of his patient to a lesion of the nuclei of the supplying nerve fibers, also stated that "the muscles in an atrophied condition were proven to be present."

Exclusive of the microscopic examination of the exterior ocular muscles in cases of incomplete congenital ophthalmoplegia (there appears to be no record of such an examination in a complete case), Li's [15] observations are important. Endeavoring to relieve the ocular muscle defects of two of his patients by a series of operations which included exposure of both internal recti and the right externus of one of them, he found the muscle fibers few, light and very thin; in another patient the internal and external recti were in a similar state and "fatty." These patients, Chinese girls, 4 and 3 years of age, respectively, had nearly complete congenital bilateral exterior ophthalmoplegia. Whether there was also aplasia of the nuclei in these patients it is, of course, impossible to say; but it would seem that the defective muscle structure was congenital and not the result of long-continued disuse.

ENCEPHALOGRAPHIC STUDIES

So far as I am aware, encephalographic studies in cases of congenital exterior ophthalmoplegia have not previously been made.[23]

The method was employed in the present case in an endeavor to determine whether gross cerebral changes were present. Dr. H. K. Pancoast's interpretation of the encephalogram has been recorded, namely, "bilateral cortical atrophy of the frontal and parietal region," and a second reading of the films by Dr. Pancoast and Dr. Pendergrass confirms in their judgment the original report, being, as they state, a conservative estimate of the cerebral lesions.

On the other hand, Dr. Temple Fay, who also examined these encephalograms at my request (he had no opportunity of seeing the patient, or of studying the report of the clinical neurologic examinations), records a much more liberal interpretation, stating in a personal letter that not only is there frontoparietal atrophy of the brain over the cortex, "but the frontal lobe on the under surface has obliterated

22. Lawford, J. B.: Congenital Defects, Tr. Ophth. Soc. U. Kingdom **8**:267, 1888.

23. An important article on encephalography is that of Pancoast, H. K., and Fay, Temple: Encephalography: Roentgenological and Clinical Considerations for Its Use, Am. J. Roentgenol. **21**:421 (May) 1929. This article contains an extensive bibliography.

the cisterna chiasmatis and rests upon the posterior clinoids . . . the chiasma appears to be flattened or pressed so that it is hardly discernible. The cisterna chiasmatis has been posteriorly displaced. The cisterna interpeduncularis assumes a posterior and extremely low position, as though the brain had been displaced backward, the frontal lobe settling over and pressing on the chiasmal structures. There is marked cerebellar atrophy, and in the stereoscopic analysis there are revealed areas of atrophy in the parieto-occipital region."

As there is no disagreement as to definite atrophy of the frontoparietal region, it is perhaps a fair inference that other "atrophies" not detectable by encephalography may be present, for instance, in the nuclear areas; these would therefore be indirect evidence that nuclear aplasia is present as one factor in the development of the exterior ocular muscle palsy.

If an actual atrophy of the frontal lobes existed, it is difficult to understand why the patient exhibited no symptoms of disorder of this portion of the brain.

Commenting on this matter in a personal letter, Dr. Spiller wrote: "The outflow of cerebrospinal fluid is toward the frontal and parietal regions; in encephalograms the air markings of these portions of the brain are usually more distinct than those of any other region, showing there is a space in this portion for the collection of air."

Because of these facts, it was his opinion that too great emphasis should not be placed on atrophy of the frontoparietal region of the brain of the patient whose case history forms the basis of this report. Some interference, he wrote, "with the outflow of cerebrospinal fluid, such as might be caused by a moderate hemorrhage into the fluid, and irritation thereby produced, might result in the appearance of atrophy which her brain presents."

Temple Fay's interpretation of the encephalogram included indications of pressure on the chiasm, so marked that it was hardly discernible. In such circumstances the ophthalmoscope should reveal an optic nerve atrophy. The optic disks of this patient, however, were entirely normal.

The peculiar distortion of the visual field found at the first examination, somewhat suggesting an impure binasal hemianopia (fig. 2), might be explained by pressure at the lateral angles of the chiasma were it not for the fact that as soon as the patient's marked improvement occurred, as already recorded, the fields became normal in extent and disposition.

There is little doubt that this original defect in the field should be regarded as an artefact or as the result of the patient's impaired cerebration due to violent headache and general physical depression.

It is difficult to reconcile the extensive lesions of the brain which Fay regarded as indicated by the encephalogram with the absence of various mental and nervous symptoms.

On the basis of a large experience with encephalography, Fay pointed out that often many symptoms which might reasonably be expected, are not present; if I understood him correctly, he believed that this was due to the compensating ability of the brain in the presence of widespread involvement.

The remarkable improvement of this patient, which occurred soon after the completion of the various investigations at the hospital, showed itself (1) in complete relief from the headache and vertigo which had existed for many years, and (2) in the disappearance of the attacks of unconsciousness, recurring amaurotic manifestations and widespread cutaneous and mucous membrane anesthesia.[24]

The elimination of headache should be ascribed to the drainage of the cerebrospinal fluid and injection of air at the time the encephalogram was made. Relief in such circumstances is well known. It corresponds with the experience of Pancoast, Pendergrass and Fay, and is referred to by Dr. Charles L. Martin in his discussion of Pancoast and Fay's paper.[23]

Dr. Pendergrass informs me that the headache usually remains in abeyance for six months. Should it return, it may again be eliminated by a repetition of the operation, even when there is a known organic lesion, as in a case of arachnitis in one of Pendergrass' patients.

The disappearance of the group of disturbances defined as "hysterical" manifestations implanted on an organic basis may be ascribed to suggestion conveyed through statements repeatedly and definitely made to the patient that as the "operations" had demonstrated that organic disease was not present (a permissible exaggeration for therapeutic influence), she would certainly recover, that is, "get well." [25]

The patient's ophthalmoplegia is best explained by assuming the combined influence of nuclear aplasia or dysplasia associated with imperfect development and structural defects of the exterior ocular muscles.

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24. Temple Fay was inclined to attribute the vertigo and "attacks of unconsciousness" to disturbed circulation of the cerebrospinal fluid and to secondary vascular influences.

25. Fay, however, in a personal communication, wrote that "the attacks of unconsciousness and vertigo are open to grave suspicion of a disturbed cerebrospinal fluid and secondary vascular influence, the background of which would require considerable study to determine whether this is a question of venous drainage or periodic attacks of water drainage."

ABSTRACT OF DISCUSSION

DR. W. I. LILLIE, Rochester, Minn.: In more than 150 cases of various ophthalmoplegic disorders observed at the Mayo Clinic, there was but one case of this type. Ophthalmologically, the lowered central visual acuity and bizarre binasal hemianopia, associated with the interpretation of the encephalogram, suggest some defect near the optic chiasm. It has been assumed by certain observers that a lesion of the posterior fossa, through distention of the third ventricle secondary to increased intracranial pressure, is sufficient to flatten the optic chiasm laterally and to produce a binasal field defect. In all such cases, examination of the fundus has revealed a choked disk of long standing with resulting secondary optic atrophy. As binasal hemianopia is rarely, if ever, elicited in any proved tumor near or at the optic chiasm unless it is bilateral, as in aneurysm (including tumors of the third ventricle), the local pathologic process in the region of the optic disks probably best explains the defect in the binasal field, similar to the defects seen in chronic simple glaucoma which are due to local lesions of the optic disk. None of these explanations suffices in the present case. I agree that perhaps the fields elicited were artefacts or the result of the patient's poor cooperation. This conclusion on the part of Dr. de Schweinitz further substantiates my opinion that a chiasmal lesion rarely, if ever, produces binasal hemianopia. The neurologic data, together with the clinical history and subsequent improvement, substantiate Dr. Spiller's interpretation of hysteria superimposed on a congenital ophthalmologic condition. The interpretation of an encephalogram is always difficult. Drs. Pancoast, Pendergrass and Fay are practically in accord in their deductions of convolutional atrophy, although clinical data do not substantiate their opinion. Numerous necropsies have revealed organic lesions of the brain out of proportion to clinical signs and symptoms. One only has to observe large lesions near the optic chiasm to realize how much abuse this structure tolerates without undue subjective or objective visual disturbance. A lateral roentgenogram of the head made before operation would have aided materially in the interpretation of the encephalogram. Undoubtedly one was made, but I could not find mention of it. Repeated roentgenograms of the nasal sinuses are reported as having been made. As the intracranial pressure was normal at the time of the operation for the encephalogram, and as the patient's disability and the clinical data were fluctuating, with an apparently good recovery following the operation, could not the "bilateral cortical atrophy of the frontal and parietal region" also be interpreted as a congenital defect?

XANTHOMATOSIS OR LIPOID HISTIOCYTOSIS

REPORT OF OCULAR OBSERVATIONS IN TWO CASES OF CHRISTIAN'S SYNDROME: A CORRELATION WITH OTHER OCULAR SYNDROMES *

PARKER HEATH, M.D.

DETROIT

This paper is divided into two parts: (1) a report of ocular observations in a diffuse lipореticular disease (Christian's syndrome [1]) and (2) suggested new classifications for a variety of ocular signs and syndromes that are apparently related.

OCULAR OBSERVATIONS IN DIFFUSE LIPORETICULAR DISEASE

Two cases are presented here: In one the condition was studied from necropsy material, and in the second the patient largely recovered from the disease. They belong in the group showing bone defects, exophthalmos and diabetes insipidus (Christian's syndrome). Both patients were referred by Dr. R. S. Rowland,[2] and the general histories and observations are condensed from his report.

REPORT OF CASES

CASE 1.—*History.*—H. S., a white boy, aged 5 years and 2 months, seen on Dec. 14, 1925, did not have a history relevant to the present condition. At 2 years and 6 months, his tonsils and adenoids were removed, at which time a soft, swollen, painless area was noted on the back of his head and was thought to be due to a fall down some steps. At the age of 3 years and 9 months, another soft swelling was noted on the right temple and was attributed to an injury against a table. A physician was consulted. Examination showed exophthalmos and convergent strabismus, with normal vision and fundi. The patient had lost many teeth; ten had been removed at one time; those remaining were loose; the alveolar processes were swollen, and he had foul breath. There was a slight serous discharge from both ears.

Roentgen examination in the Children's Hospital of Michigan showed multiple cranial defects involving both tables of the skull and one large area in the occipital region, with complete erosion of both tables. Examinations of the blood and spinal fluid gave negative results.

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* Submitted for publication, July 1, 1930.

* Read before the Section on Ophthalmology at the Eighty-First Annual Session of the American Medical Association, Detroit, June 27, 1930.

1. Christian, Henry: Defects in Membranous Bones, Exophthalmos and Diabetes Insipidus, Contributions to Medical and Biological Research, New York, Paul B. Hoeber, 1919, vol. 1, p. 390.

2. Rowland, R. S.: Xanthomatosis and the Reticulo-Endothelial System, Arch. Int. Med. **42**:611 (Nov.) 1928.

A mild pertussis developed. The exophthalmos gradually increased—on the right more than on the left side—while the soft areas on the head increased in size. No headache, pain, tremor, irritablity, convulsions or disturbances of gait, hearing and mentality were evident. Speech was not distinct.

Examination.—On examination, December 14, the patient appeared fairly well nourished but undersized. For three months he had had difficulty in walking, increasing shortness of breath and a dry cough. Examination showed a swelling with pulsation in the frontal region covering an area 5 by 7 cm., which protruded with straining; the bony edge was sharply defined. There was a similar area in the right temporal region (4.5 by 3.5 cm.) and a smaller area in the left parietal region (2 cm. in diameter). There were other areas with slightly elevated surfaces. The eyes showed well marked exophthalmos, especially the right eye,

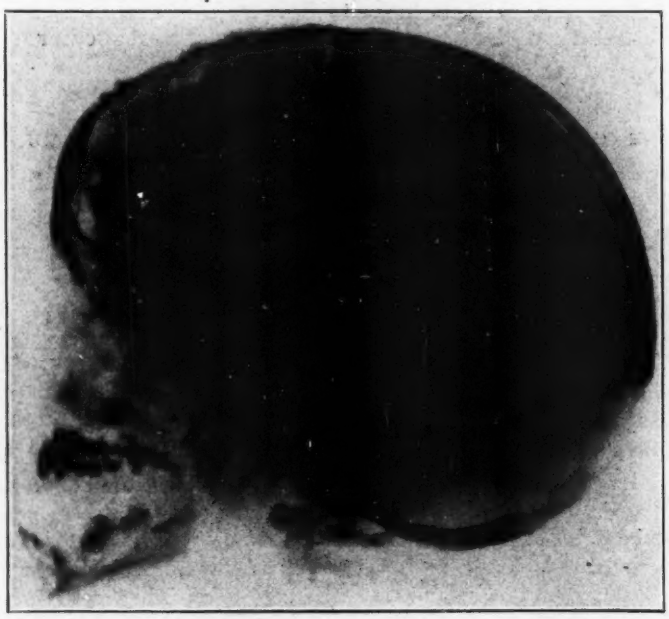

Fig. 1 (case 1).—Lateral aspect, showing severe multiple defects in the left side of the skull (December, 1925).

which turned down as well as in. The pupils were slightly dilated and equal, and reacted normally to light and in accommodation. There was no extra-ocular paralysis or nystagmus. The fundi were normal.

There was a thin purulent discharge from both ears, and the tympanic membranes were partially destroyed. The bridge of the nose appeared depressed. The nasal mucous membrane was swollen. Three loosened teeth remained. The breath was foul, the alveolar arches were irregularly swollen and bled easily, and the tongue was heavily coated.

The heart was enlarged. The blood pressure was 80 systolic and 40 diastolic; the pulse rate was 126. The lungs were hyperresonant, with occasional coarse râles in both bases. The abdomen was moderately distended but not tender. The extremities showed small, flabby muscles and slight edema of the ankles.

The knee reflexes were normal. The Babinski, Kernig and Brudzinski signs were not elicited, and the plantar reflexes were normal.

Laboratory examinations of the urine were not significant. The blood hemoglobin (Dare) was 57 per cent; the red blood cells, 4,150,000; the white cells, 17,350, with a differential count of polymorphonuclears 64 per cent, large mononuclears 32 per cent and small lymphocytes, 4 per cent. The intradermal tuberculin test was negative, as was the Wassermann reaction of the blood.

A roentgen report of the blood on December 15 by Dr. Lawrence Reynolds, who also made the subsequent reports unless otherwise stated, showed multiple cranial defects of both tables of the skull. The frontal, parietal and occipital bones were involved, especially the frontal, the maxillae and to a lesser extent the mandibles. The sella turcica was distinctly visible; the fossa was of normal depth, and there was some demineralization of the dorsum sellae. The chest films showed a diffuse bilateral fibrosis, simulating the pneumonoconiosis seen in mineworkers' chests. The heart was enlarged on both sides.

Fig. 2 (case 1, referred by Rowland).—Exophthalmos persisting post mortem.

The clinical diagnosis was membranous defects of the bones, exophthalmos and dwarfism. Generalized xanthoma of a so-called visceral type was found.

Course.—After December 23 the patient grew progressively weaker. Edema of the dependent parts of the body increased. He was removed to Harper Hospital on Jan. 1, 1926, where he failed rapidly and died on the following morning. The fatal termination was attributed to cardiac failure due to impaired circulation resulting from the extensive pulmonary fibrosis.

Autopsy (by Dr. P. F. Morse on Jan. 3, 1926).—There was extreme pallor of the skin and marked exophthalmos of the type seen in cavernous sinus thrombosis. The fingers, toes and lips were markedly cyanosed. There was a serous discharge from both ears. Palpation of the skull revealed many cranial defects in which the bone appeared to be missing.

When the head was opened, the scalp was found normal in appearance. When the calvarium was exposed there were numerous annular defects of the cranial bones which varied from 0.75 to 4 or 5 cm. in diameter. These defects had slightly wavy edges, but were fairly sharp. The bone at the margin was firmer than normal and the defect itself was filled with a gummy, semicaseous bright yellow tissue of rubbery consistency. The tissue appeared to be uniform in structure and on section presented the same appearance that it did externally. When the skull cap was removed, it was found that the tissue was easily pushed out of these defects, leaving a somewhat ragged hole in the skull. This tissue appeared to arise from and be continuous with the dura, and to give the impression of a peculiar form of granulomatous tissue arising from the dura and invading the skull. The brain was somewhat edematous. The dura stripped easily from its superior surface. When the brain was removed, a gross lesion of the brain substance or ventricular system was not discovered. When the base of the skull

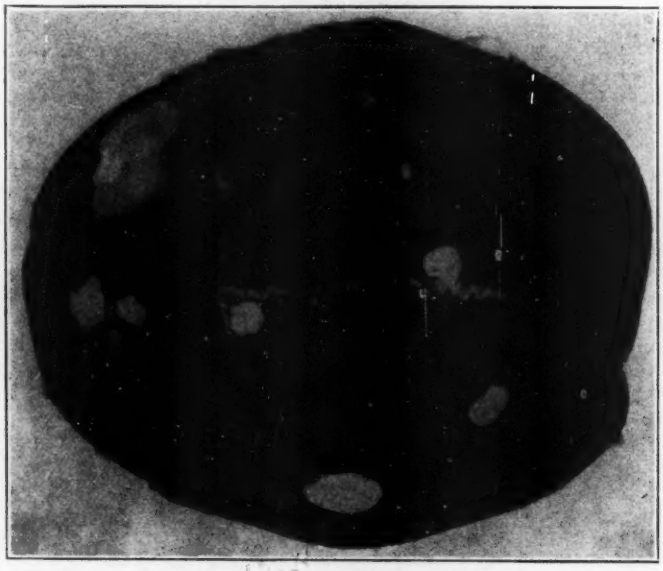

Fig. 3 (case 1).—Superior aspect of skull at autopsy showing varied borders of defects (Jan. 3, 1926).

was inspected, it was found irregularly covered with these yellowish, granulomatous swellings which had destroyed a large portion of the bone of the base, extending forward into both orbits and completely surrounding the region of the hypophysis and destroying the sella turcica. The nasal sinuses did not show anything noteworthy. When the temporal bone was opened, the tympanic membranes were found to be destroyed, and there was a marked atrophic inflammatory process of both middle ears without destruction of the bone.

When the body cavities were opened in the usual manner, the sternum appeared normal with a normal marrow content. The heart was markedly enlarged and dilated on both right and left sides. When the heart was removed there was a moderate hypertrophy of the muscle of both ventricles and relative dilatation of the tricuspid and mitral rings, but no other cardiac lesion. The first portion of the aorta and coronary vessels appeared normal. The lungs were voluminous and felt fibrous to palpation. The left lung was somewhat adherent over the posterior

lateral aspect of the costal pleura, the adhesions being of the same peculiar yellowish, gummy nature that was noted in the granulomas of the skull. When the lungs were removed, they were found distended and firm to the touch and on section presented a remarkable appearance. The whole lung was a mass of communicating vesicular cavities. These cavities varied in size from that of a pin head to that of a large pea. The septums between the cavities were fibrous and inelastic. The walls of the blood vessels were somewhat thickened. The general appearance suggested a low-grade pulmonary hypoplasia, or an intense or diffuse form of pneumonitis with marked emphysema.

When the abdomen was inspected, the liver was found to be about normal in size. On section, it did not present a remarkable appearance. The spleen was normal. Both kidneys were normal in size, and on section presented a normal relation of the cortex to the medulla. The capsule stripped easily. The gastrointestinal tract, including the pancreas, did not present gross pathologic changes. The pelvic organs were normal. In the cavity of the right ilium there was a yel-

Fig. 4 (case 1).—Hyperplastic dural plaque.

lowish plaque about 1 cm. in diameter with a bone defect of the same character as that seen in the skull. A similar yellow plaque, 2 cm. in diameter, protruded from the periosteum on the right side of the body of the first lumbar vertebra.

Roentgen study of the skull cap at the time of autopsy revealed in a striking way the cranial defects that were observed in the roentgen study of the skull during life: Some of the defects showed a sharp discrete outline of their "bony borders," whereas others had a more or less moth-eaten appearance. This was especially true of the frontal bone on the right side.

Pathologic Examination (by Dr. A. S. Warthin).—The thyroid gland showed a colloid content normal for the age of the patient, with undeveloped adenomatous tissue. Throughout the gland there were a number of sharply circumscribed areas of proliferation of the stroma having an epithelial appearance in the center with some lipoidosis.

The suprarenal glands showed hypoplasia, which was especially marked in the medulla. Moderate lipoidosis of the cortical cells was present. In the perisuprarenal tissue there were small areas of proliferating reticulo-endothelium. The large epithelioid cells showed more lipoidosis and some pigmentation, thus

resembling xanthoma cells. In one section in the medulla were small areas of proliferating reticulo-endothelial cells with lymphocytic infiltration.

The lymph nodes showed lymphoid exhaustion of the germ centers. Proliferation of the reticulo-endothelium with lipoidosis and slight pigmentation was present. The proliferation of the reticulo-endothelium and lipoidosis varied greatly

Fig. 5 (case 1).—Low power view through dural plaque.

Fig. 6 (case 1).—High power view through dural plaque. Both figure 5 and figure 6 show lipoid (foam cells) and foreign body giant cells.

in the different nodes, being marked in some and slight in others. All through the retroperitoneal tissue there were bands and strands of this atypical tissue.

The kidneys were congested with edema and some lipoidosis of the renal epithelium. Small concretions of lime salt were found in some of the tubules. Proliferation of the reticulo-endothelium and lipoidosis were not found.

Brain sections did not show any pathologic change except slight edema.

The liver presented marked passive congestion. There was slight lipoidosis of the liver cells, more marked in the periphery of the lobules, and some atrophy of the cells. Many lipoid Kupffer cells were found.

The lungs showed chronic bronchopneumonia, with localized patches of fibrosis and alternating patches of emphysema. The reticulo-endothelial cells around the pulmonary vessels showed the same hyperplasia and lipoidosis seen elsewhere, and projecting into the larger bronchi were papillary overgrowths of fibroblastic tissue and reticulo-endothelial tissue showing lipoidosis. The pleura was thickened with reticulo-endothelial hyperplasia and lipoidosis.

The heart muscle fibers were fairly well developed for the age of the patient. Little lipoidosis of the muscle, no reticulo-endothelial proliferation and no lipoidosis in the stroma were found. The tests were apparently normal for the age. Lipoid cells were not found in the testes or epididymis.

The pineal gland was edematous and congested. Lime salt deposits or lipoid cells were not present.

The bones showed atypical marrow. There was reticulo-endothelial hyperplasia with many multinuclear giant cells and many lipoid cells. Rarefaction of the bony trabeculae was found. (The bone absorption resembled that seen in some cases of osteomalacia.)

The dural plaques consisted of masses of lipoid-containing cells of reticulo-endothelial type resembling xanthoma. Throughout were numerous multinuclear giant cells. In old tissue of the dura were numerous small calcareous concretions. In lipoid masses were areas of cholesterol crystal formation, with cholesterol clefts and with many multinuclear giant cells. Giant cells, evidently foreign body giant cells, surrounded the cholesterol crystals. These plaques did not suggest infectious granuloma, but resembled xanthoma or masses of cells of the xanthoma type, and probably consisted of proliferated reticulo-endothelial cells with cholesterolosis. Fat stain showed the cells to be loaded with lipoid.

CASE 2.—*History.*—R. R., a white boy, aged 3 years and 11 months, seen on Feb. 14, 1926, did not have a history significant for the present condition. When less than 2 years of age, he became irritable, complained of a sore mouth, and began to ask for water frequently and to pass large amounts of urine. When 22 months of age he stood in a rocking chair which was tipped over sidewise, and in falling he struck his head. For about four days, he was drowsy and irritable, complained of pain and slept a good deal. The soreness of the mouth grew worse, and several of the teeth loosened and came out. At 26 months he had a second fall, after which considerable swelling appeared over the frontal bone. This was again followed by drowsiness and stupor. About this time he had suppurative otitis media on the left side. On Sept. 12, 1924, when 2 years and 6 months of age, he was admitted to the Children's Hospital of Michigan. Examination showed that he was well nourished. In the left parietal region there was a cranial defect 22 mm. in diameter; there were small palpable glands of the posterior cervical chain, and the abdomen was slightly distended. The rest of the physical examination gave negative results.

Previous Laboratory and Special Examinations (from the Children's Hospital record).—The urine was clear and alkaline, with a specific gravity of from 1.000 to 1.003; albumin and sugar were not present. The Bence-Jones albumose test was negative on repeated examinations. Microscopic examination gave negative results. Examination of the blood showed: red blood cells, 3,850,000 and white blood cells, 9,800. The differential count showed: polymorphonuclears, 71 per cent; large mononuclears, 3 per cent, and small lymphocytes, 26 per cent. The

urea nitrogen was 16 mg. per hundred cubic centimeters. The blood sugar was 60 mg. per hundred cubic centimeters. The Wassermann reaction of the blood was negative. Two dextrose tolerance tests showed blood sugar well within normal limits. The amount of urine was not increased by the test, nor did sugar appear in the urine. The response to solution of pituitary was pronounced at first, but the dosage had to be increased and was discontinued before the patient left the hospital because the therapeutic effect was not satisfactory. The Pirquet test was negative. The cerebrospinal fluid was clear and under normal pressure. The cell count was 8 per cubic centimeter; the globulin test and the Wassermann reaction of the spinal fluid were negative.

Roentgen Examination.—A report from the Children's Hospital of Michigan on Sept. 16, 1924, stated that the skull showed evidence of multiple cranial defects. One large defect involved the entire base of the skull and frontotemporal region on the right side. The process had entirely destroyed the floor of the sella, only the anterior clinoid processes and dorsum sellae remaining as landmarks. A large

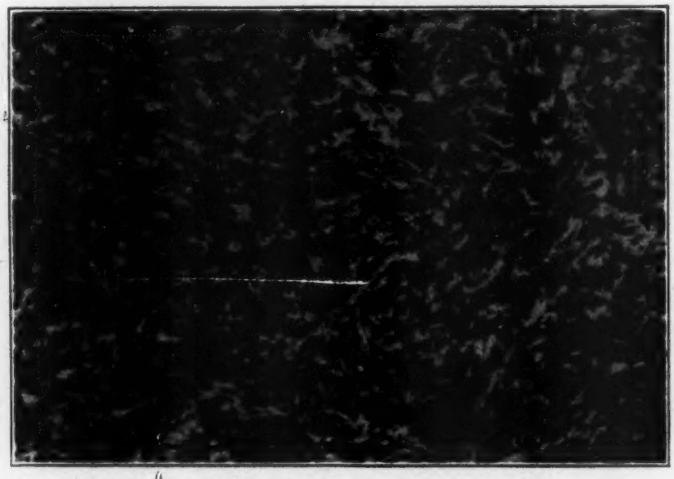

Fig. 7 (after Rowland).—Dural plaque stained with sudan III shows a high content of fat.

defect also appeared in the left parietal region near the vertex of the skull and a smaller one in the vertex. There was evidence of involvement of the fifth rib on the right side in the posterior axillary region. No involvement of the long bones was apparent, but there was an area of decreased density in the right ilium.

During the patient's stay of more than two months in the hospital, his temperature ranged from 97.7 to 99.6 F., with an occasional unexplained elevation as high as 101 F. For about a week there was moderate elevation of temperature, resulting from a small abscess in the right buttock, which was opened and drained. A rise also occurred following resection of a portion of the fifth rib which, according to the roentgen reports, showed changes similar to those in the skull. A specimen was taken for microscopic examination, but no report was made. The pulse rate varied from 110 to 140, and the respirations from 24 to 30 a minute. The weight fluctuated considerably, with variations in the fluid intake and output, but it was 23 pounds and 7 ounces (10,631 Gm.) on the patient's admission to the hospital and 21 pounds and 14 ounces (9,922 Gm.) on discharge.

The following possibilities were considered in the diagnosis at this time: A syphilitic destructive process, sarcoma or myeloma. The patient was discharged on November 20, unimproved, to return when the condition became more serious.

Dr. Rowland first saw the child on Feb. 14, 1926, fifteen months after he had left the hospital. The only complaint was of sore mouth and moderate thirst. He passed from 6 to 8 quarts (from 5.6 to 7.5 liters) of urine in twenty-four hours. The mother had noticed that he had not grown like her other children, and that the soft spot on the head had increased in size.

Fig. 8 (case 2, referred by Rowland).—Left exophthalmos; normal proportions of the body.

Physical Examination.—The boy appeared fairly well and not in pain. The skeletal proportions were normal, though small for his age. He weighed 28 pounds (12,690.5 Gm.), and was 35 inches (88.9 cm.) tall. The temperature was 99 F., the pulse rate 116 and respirations 26. The skin was clear, elastic and dry, without any eruptions. The panniculus was well developed, without abnormal deposits of fat. The glands were not enlarged. The head was symmetrical and square, with a normal amount of light brown hair. On palpation, an irregular

oblong defect, measuring 3 by 4 cm., was felt in the skull in the left parietal region near the vertex. The edges were sharply defined. There was little if any tenderness on pressure. The left eye was slightly more prominent than the right. The pupils were equal and regular and reacted to light and in accommodation; the sclerae were bluish; photophobia, diplopia, nystagmus or palsies of the extrinsic eye muscles were not present. Graefe's sign was not present. The fundi appeared normal. The ears were normal. The nose was small; its passages were narrow; the mucous membranes were swollen, and there was a slight nasal discharge. The mouth was small; the gums were swollen and tender, bled easily and were retracted from the teeth. All the molar teeth in both the upper and the lower jaw were loose. The teeth appeared normal. Pus could be expressed about some of them. The tongue protruded in the median line without tremor. The tonsils were moderately enlarged and, with the pharynx, were congested. The

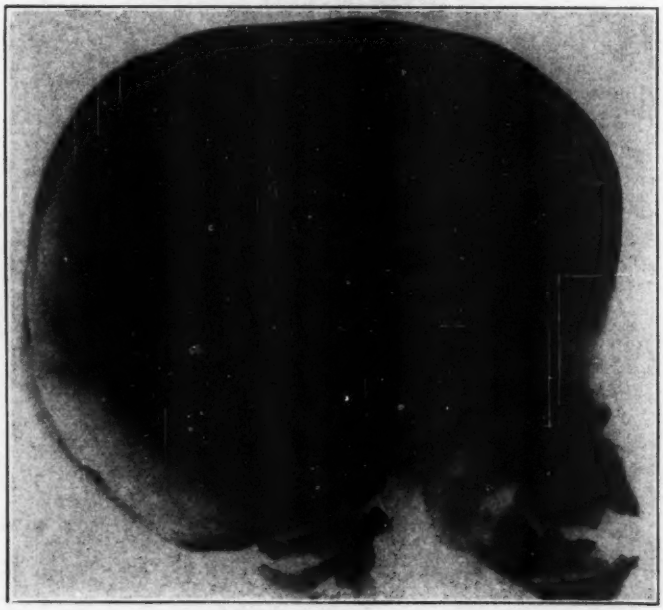

Fig. 9 (case 2).—Parietal defect and defects in the base (Nov. 1, 1924).

voice was of good quality. The neck did not show abnormal pulsations. The thyroid was not palpable. The heart showed an apex impulse in the fifth space just inside the nipple line. The action was regular, the sounds were of good quality, and no murmurs were present. The lungs showed good resonance, and normal breath sounds were heard throughout. The abdomen was moderately distended but not tender. The spleen was not felt. The edge of the liver was palpable below the costal margin in the nipple line. The superficial and deep reflexes of the extremities were all normal. The genitals were normally developed.

Roentgen examination on Feb. 20, 1926, revealed marked extension of the erosion which had involved the right and left parietal bones. The process had extended posteriorly and now involved the temporal bones on both sides, continuing on the right side as far as the occipital bone in the region of the lateral

sinus. There was definite involvement and destruction of the mastoid cells, except for one or two cells in the region of the antrums, which were still pneumatic. In the film taken in the postero-anterior plane one was able to note the rather extensive process which had involved the supra-orbital plate on both sides, this process being more extensive on the right side, where there was definite involvement of the frontal bone and extension into the superior and lateral orbital ridges. The maxillae were also involved. There was erosion of the lateral wall of the left maxilla and clouding of the antrum. Examination of the chest revealed evidence of repair of bony structure in the shaft of the fifth rib in the posterior axillary line, at the point where the specimen was removed for biopsy. However, there had been an extension of the process anteriorly in the shaft of the fifth rib. None of the other ribs was seen to be involved, and all the long bones were normal in appearance.

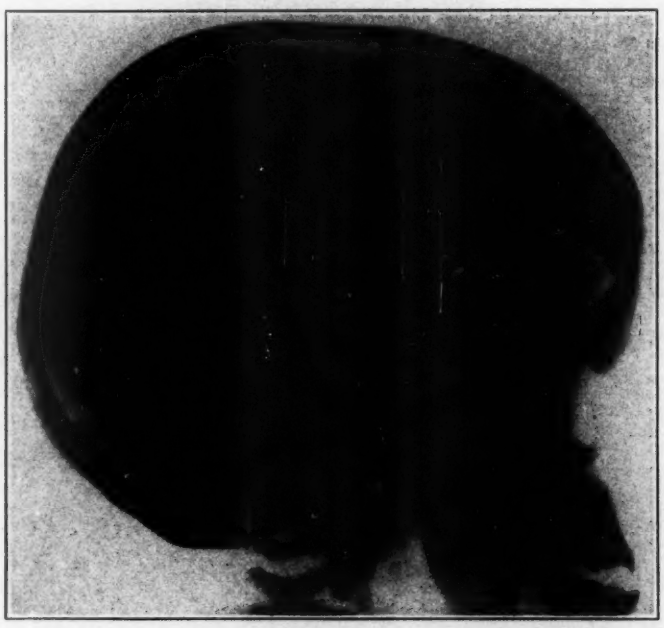

Fig. 10 (case 2).—More extensive loss of bone (Feb. 20, 1926).

A determination of the blood serum cholesterol at this time gave a value of 315 mg. per hundred cubic centimeters (Myer-Wardell method).

The condition was diagnosed as membranous bone defects, exophthalmos, diabetes insipidus and generalized xanthoma of a visceral type.

Laboratory Study and Special Examination.—On April 18, the patient was admitted to Harper Hospital. In general, the results of laboratory examinations corresponded to those previously obtained: The urine was amber, acid and negative for albumin and sugar, with a specific gravity of from 1.000 to 1.004. It varied in daily amount from 5,000 to 6,000 cc. Under the administration of sodium chloride there was little tendency to concentration, and the sodium chloride was readily excreted. The Mosenthal test demonstrated the large increase in the excretion of water and also that the amounts excreted during the day and night

were in normal relation. The excretion of chloride and nitrogen was within normal limits. Solution of pituitary, given by mouth, had no effect; but obstetric pituitary solution, given hypodermically, reduced the amount of urine to normal and did not materially affect the specific gravity. The dextrose tolerance test showed: fasting, 0.087 per cent; one hour, 0.117 per cent; three hours, 0.083 per cent. The urine was not increased, and sugar did not appear in the urine. Examination of the blood showed: hemoglobin (Sahli), 68 per cent; erythrocytes, 5,600,000; leukocytes, 13,500, with a differential count of polymorphonuclears 67 per cent, large mononuclears 7 per cent, small lymphocytes 24 per cent and eosinophils 2 per cent. Six separate examinations of blood cultures gave negative results; one showed contamination, and two anaerobic cultures were negative. Blood chemical determinations showed: nitrogen, 23 mg.; sugar, 60 mg.; calcium,

Fig. 11 (case 2).—More elaborate loss of bone (April 22, 1926).

9 mg.; uric acid, 4 mg.; cholesterol, 256 mg., and fatty acids, 400 mg., all per hundred cubic centimeters of blood serum. The spinal fluid cell count was 8; tests for globulin were negative, and the colloidal gold curve was 000000000; the Wassermann reaction was negative; cultures from the fluid did not show growth, and injection into guinea-pigs gave negative results. Intradermal tuberculin tests were negative. Basal metabolism tests were attempted, but were considered unsatisfactory. Pharmacologic tests, in which varying doses of the anterior lobe of the pituitary and obstetric pituitary solution given hypodermically were used, did not give a reaction that could be regarded as abnormal, suggesting that a disturbance of pituitary function had not occurred.

Characteristics of Growth.—Examination by Dr. C. J. Marinus on April 22 showed that the face was definitely square, with some flattening of the nose, a small mouth, and eyes slightly suggestive of the mongolian type. The skin was

definitely dry. The hands and feet were of good size and proportion. The following measurements were taken: circumference of the head around the forehead, 19 inches; vertical across the jaws, 20 inches; largest circumference, 20 inches; neck, 9½ inches; shoulders, 20½ inches; chest, 20 inches; abdomen, 19 inches; span, 34½ inches; sitting height, 19½ inches; lower half, 16½ inches; upper arm, 9½ inches; lower arm, 10½ inches; thigh, 10½ inches; leg, 10 inches. These measurements were normal, the height being greater than the span, and the lower half somewhat less than the upper half. There was no evidence of insufficiency of the anterior lobe of the pituitary, as shown by the bone development. There was no deficiency of the posterior lobe, as shown by lack of fat changes. The dryness of the skin was that usually seen in diabetes insipidus due to disturbed

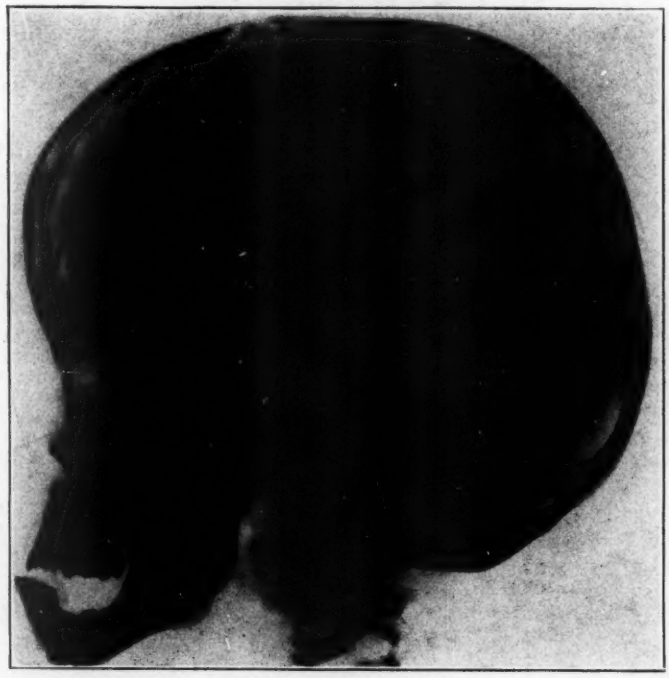

Fig. 12 (case 2).—Remarkable bony regeneration in twenty-one months (Oct. 27, 1927).

water balance rather than that due to thyroid insufficiency. At this examination the patient did not show any developmental changes characteristic of pituitary disease. There was a moderate dwarfism which, however, was not characteristic. The signs by which pituitary insufficiency is customarily diagnosed do not usually appear before the age of 8. This case was of particular interest because the roentgen examination presented positive evidence of pituitary injury and because of the diabetes insipidus. The proportions in anterior lobe deficiency tend to resemble those in infancy, so that in a patient of this age it is impossible to say whether the decrease in height is due to pituitary insufficiency or whether it belongs in the class of true dwarfism.

Ophthalmic examination, on April 24, showed that the vision in each eye, as determined by objects, was normal for distant and near vision. The convergent

power was normal; there was no paralysis of the extrinsic muscles. The pupils were equal in diameter and reacted promptly to light and in accommodation; consensual reflexes were present. The left eye was more prominent than the right, being proptosed approximately 2 mm. The lidlag sign found in exophthalmic goiter was not present. Neither globe was congested. On ophthalmoscopic examination of the right eye the pupil dilated evenly; the media were clear; the disk was normal in color; the rings were slightly blurred; the vessels were normal in caliber and course, and foveal reflexes were present. Examination of the left eye showed essentially the same condition.

Roentgen Report.—On Oct. 27, 1927, a striking change was noted. The previously large cranial defects showed complete bony regeneration, except for a

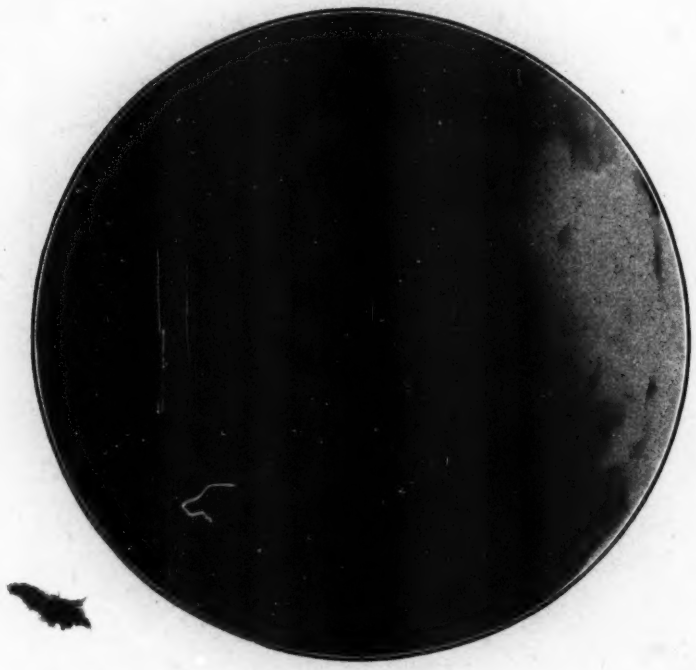

Fig. 13 (case 2).—Orbitis with extensive destruction of bone, especially on the left side.

small discrete area in the left parietal bone, where a large defect was formerly observed. It was possible to make out only the faintest cranial defect, and this was limited to the inner table. The large defects noted in the region of the anterior and middle fossa on the right and left sides showed complete regeneration. There had been, however, no attempt at repair of the sella turcica, although the supra-orbital plates showed distinct bony repair. The pelvic and long bones revealed no evidence of abnormality, and at no time had there been any destruction of the long bones, other than the shaft of the fifth rib on the right side.

Course.—On November 8, the patient appeared well, was lively and had a good color. Measurements showed that he had gained 3½ inches (8.8 cm.) in height during the past year. The exophthalmos had noticeably receded. The soft spot in the left parietal region was markedly reduced in size, so that it could be located only with difficulty. The sinuses and teeth were in good condition. The

boy rarely asked for water and passed less than 3 quarts (2,839 cc.) of urine during the day and about half this amount at night, in comparison with twice that much a year before. A determination of cholesterol showed 111 mg. per hundred cubic centimeters of blood serum.

March 16, 1930, the left exophthalmos was scarcely measurable. Ophthalmoscopic examination was negative. Roentgen examinations of the head showed nearly complete bony repair except of the sella turcica. The general health, including gain in height, showed improvement.

COMMENT

The exophthalmos and its mechanism in this group is of prime interest. The softening and bony loss at the apex of the orbit, especially

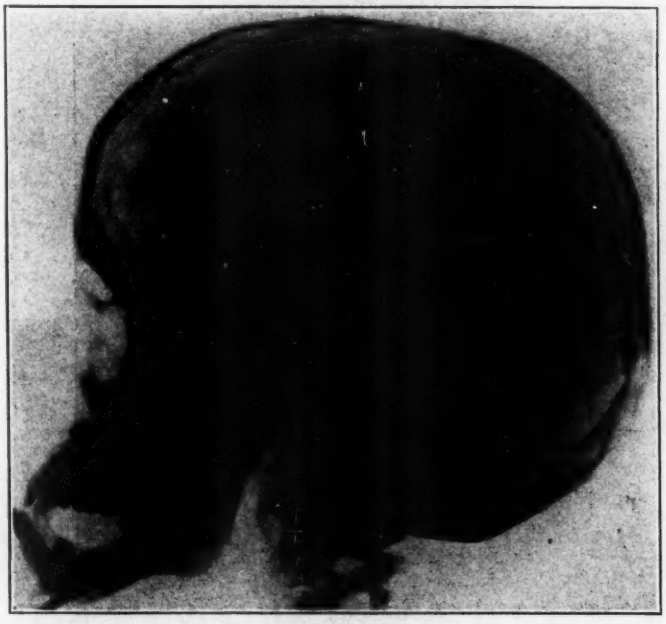

Fig. 14 (case 2).—Marked regeneration and repair of bone, nearly normal appearance; dorsum sellae not repaired (March 16, 1930).

on the right side, found in case 1 at necropsy, allowed anterior pulling forces to draw the globe forward. The regularity of the proptosis in case 2, with useful movement in all directions, indicated that the extrinsic muscles were affected not singly but as a group. The forward position of the globe was dependent on the symmetrical easing forward of the apex of the orbit with its muscular ring attachments and the accompanying xanthoma masses in the orbit. The early roentgenograms in case 2 bear out this opinion. Further, the improvement with respect to the exophthalmos is apparently proportional to the bony regeneration. The defects in the region of the anterior and middle fossa and supraorbital plates were largely repaired by October, 1927. During the

earlier and more active stages of the disease, the degree of exophthalmos may have been somewhat less after rest on the back, but this was not established definitely. The good vision and complete freedom from a fundus lesion are significant of relative minimal disturbance within the orbits by pressure. Another mechanism of conventional type in exophthalmos is that of multiple yellow masses deposited in the orbit without destruction of bone. This manifestation of xanthomatosis is one of several reported in adults, in whom serous surfaces were largely involved. This variety of the disease is illustrated by a case reported by Dietrich.[3] The autopsy showed yellow masses in both orbits, about

Fig. 15 (case 2).—Repair of orbital plates well shown (March 16, 1930).

the vessels of the brain, involvement of the hypophysis by pressure, retroperitoneal masses, and kernels scattered on the surfaces of the liver and spleen, pleura and pericardium.

All of the cases (seventeen reported in Rowland's paper and eight in personal communications) reported under various titles in the generalized type affecting children showed bony defects in association with xanthoma plaques and nodules, principally affecting membranous bones but not exclusively. Why the skull is chiefly affected is not clear.

3. Dietrich: Ueber ein Fibroxanthosar mit eigenartiger Ausbreitung und über eine Vena cava supra sinistra bei dem gleichen Fall, Virchows Arch. f. path. Anat. **212**:119, 1913.

The bony destruction could result from a quartet of factors present: localized foci within the marrow, pressure, nutrition loss, and the activity of foreign body giant cells. The lesions are not infiltrative in the neoplastic sense and seem to be a manifestation locally by deposit with cell proliferation in a general metabolic disease.

As described in the necropsy report, the pathologic changes diffusely involve the so-called reticulo-endothelial system, and the signs and symptoms follow secondarily, dependent on the location of the deposits and erosions. Excess of lipoids in the blood plasma apparently can be taken up by mesenchymal tissue cells, the latter proliferating, especially when irritated by some means. The xanthoma nodules are made up of masses of proliferated reticular cells with many multinuclear giant cells.

Fig. 16 (case 2).—Recession of exophthalmos (March 16, 1930).

In older areas are cholesterol crystals, calcareous deposits and foreign body giant cells. When the process is carried on long enough, a scar made up of spindle cells and fibrous tissue results. The great difference between microscopic pictures early in the disease and the late reparative scar stages, well described in the skin by Pollitzer and Wile,[4] have confused understanding of the whole pathologic process.

Other manifestations of this syndrome are of interest. The diabetes insipidus seems to result from pressures at the base of the brain and on the hypophysis or from proliferation, storage or both within the hypophysis. In the group reported, all had diabetes insipidus except

4. Pollitzer and Wile: Xanthoma Tuberosum Multiplex, J. Cutan. Dis. **30**: 235, 1912.

two patients. Dwarfism was a common observation in the cases reported; the cause was not known. Mastoid bone and dental periosteal involvement were also common observations. The exaggerated lung fibrosis, found in most of the patients at necropsy, is of great pathologic interest. The large reticular cells do not ordinarily pass through the lungs and enter the periphery. There may be an early accumulation of these large cells in the lungs, leading to fibrosis. It has been suggested that fat metabolism may be an important function of the lungs.

Chemical studies of the blood suggested the importance of hypercholesterolemia as a factor among several causing the disease. Examples of congenital and familial blood cholesterol have been found. Still further suggestions from studies of the blood apply to treatment in that a low cholesterol intake in food lowers the amount of this substance in the blood. In patient 2, with a restricted fat intake, the administration of desiccated thyroid and anterior lobe of the pituitary by mouth, resulted in great improvement in health and lessened bone destruction.

Medical literature in general contains many scattered facts about fats, lipoids and the entrance of these substances into the blood. The middleman between blood and other tissue seems to be an intermediate metabolic tissue. This is made up of reticular cells of organs and periadventitial cells of small blood vessels—a diffuse tissue. The pathologic presence of lipoids in a tissue has been ascribed to several causes: excess amount in circulation; local cells unable to use or oxidize lipoids normally, so that the latter accumulate; the result of storage; degenerations of local or adjacent tissue; ingestion of lipoids by certain cells; special diathesis; lung and liver dysfunction; acquired biologic characteristics, and the simultaneous presence of certain local activating stimuli. Some local stimuli mentioned are: friction and rubbing of the skin for the palpebral localization; mosquito bites; vaccination scars; trauma; influenza-like infection and stasis.

Experimentally, in the rabbit Anitschkow [5] induced lipoid storage and a mesenchymal mobilizing reaction by a high cholesterol diet, and simulated various xanthoma syndromes.

It is evident from the wide distribution of the intermediate metabolic tissue how diffuse its disease may be and how isolated and varied localized pathologic changes may be. Broders [6] described xanthoma

5. Anitschkow: Ueber experimentell ergengte Ablagerungen von amisotropen Lipoidsubstanzen in der Milz und in Knochenmark, Beitr. z. path. Anat. u. z. allg. Path. **57**:201, 1913; Anhaüfungen von Xanthomzellen im subkutanen Bindezewebe des Kaninchens, München. med. Wchnschr. **60**:2555, 1913.

6. Broders, A. C.: Benign Xanthic Extraperiosteal Tumor of the Extremities Containing Foreign Body Giant Cells, Ann. Surg. **70**:574 (Nov.) 1919.

affecting the extremities and noted that these benign tumors masquerade under the following names: sarcoma, myeloid sarcoma, myeloid endothelioma, myeloxanthoma, granuloma, giant cell tumor and giant cell sarcoma.

Pick,[7] after important studies in this field, considered Gaucher's disease to be constitutional, familial and due to a complex lipoid (principally sphingogalactocidokerasin) selectively stored in reticular cells of the spleen, liver, lymph nodes and bone-marrow. The cells are large and have a fibrillar stain-resistant protoplasm. In Niemann-Pick's syndrome the lipoid (principally a phosphatide) is deposited in the entire reticular system. The cells are the large vacuolated "foam" type. Christian's syndrome has the diffuse distribution, but the similar "foam" cells contain, besides phosphatides, cholesterol, anisotropic bodies and neutral fats. The adult forms show intracellar storage of similar fat bodies in different proportions. Rowland,[8] in his important paper, constructed two clinical groups:

1. Gaucher's disease—with infantile, early childhood and adult forms well correlated.

2. Simple lipoid cell hyperplasias in which there is at present no unity—represented by Niemann's syndrome in infancy, Christian's syndrome occurring in early childhood, and the various types of xanthomatosis which appear in later life—representing the adult forms of this disease.

SUGGESTED CLASSIFICATIONS OF RELATED SYNDROMES

The correlation of varied pathologic manifestations formerly thought separate diseases marks an advance in medicine. This process is more than a simplification; it is the beginning of real knowledge. The method is actively shown in the literature on general pathology, and is currently illustrated by the correlation of Gaucher's, Niemann-Pick's and Christian's syndromes. Ophthalmology has contributed important aid toward solving some obscure processes of disease. As in other branches of medicine, there is a considerable likelihood that some ophthalmic patterns thought separate and distinct will be found to be part of a broad general disease; also various purely ocular clinical pictures may have common causes. Our concern is to find sufficiently basic similarities to relate what had seemed separate diseases.

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7. Pick, L.: Die Histio- und Pathogenese des Morbus Gaucher, seine histio- und pathogenetische Abgrenzung von ähnlichen Krankheitszuständen, insbesondere der lipoidzelligen Splenohepatomegalie (Ty., Niemann), Med. Klin. **20**:1526 (Nov. 2) 1924; Der Morbus Gaucher und die ihm ähnlichen Erkrankungen, Ergebn. d. inn. Med. u. Kinderh. **29**:519, 1926; Ueber die lipoidzellige Splenohepotomegalie, Ty., Niemann-Pick als Stoffwechselerkrankung, Med. Klin. **23**: 1483 (Sept. 30) 1927.

8. Rowland, R. S.: Christian's Syndrome and Lipoid Cell Hyperplasias of the Reticulo-Endothelial System, Ann. Int. Med. **2**:1277 (June) 1929.

Ophthalmic clinical names, especially chorioretinal, are too often derived from the appearance and location of the lesion rather than from the broad underlying pathologic basis. This dissatisfaction toward ophthalmoscopic nomenclature is widely felt and frequently expressed. Terms often used are incompletely descriptive, such as circinate, massive and albuminuric, or terms with different meanings are used interchangeably, such as exudates, degenerations, proliferations and deposits. In this part of the paper it is assumed that when important manifestations become common to several syndromes a need may exist for correlation. Intimately related to the eye are a number of clinical syndromes with certain similarities. These similarities may be constitutional and familial tendencies, diseases emphasized by exudates or deposits, or similar courses in common tissues. Experimental evidence presented in the literature concerning some of the signs to be mentioned is largely supportive of this postulate. A common pathologic basis was suggested by the rapidly growing literature [9] concerning the reticular tissue—the so-called mesenchymal reactions—and particularly lipoid reactions.

In the cornea the proof is substantial that arcus senilis is a local storage reaction to blood serum lipoids. An arcus similar to the senile type is occasionally found in children with hypercholesterolemia. Experimentally, Versé [10] was able to produce in rabbits by high cholesterol diets a ring opacity similar to arcus senilis. Hanssen [11] studied the lipoid deposits in human and rabbit eyes and found deposits in the cornea and sclera, especially in the glass membranes of the cornea and choroid. Report has been made of xanthoma plaques in both the cornea and the conjunctiva. Henle warts, commonly seen in the aged as excrescences of Descemet's membrane, probably are lipoid or lipoprotein deposits. The apparently more complicated peripheral deposits in Descemet's membrane found in Wilson's disease, and associated with changes in the liver and elsewhere, are suggestive of a reticular disease. The distribution of deposit, familial tendency and frequent bilateral involvement are similarities.

According to studies by Bachstetz,[12] Verhoeff,[13] Clapp [14] and Holloway and Fry,[15] vitreous bodies are cholesterol crystals and calcium

9. Jaffé, R. H.: General Review: the Reticulo-Endothelial System, Arch. Path. **4**:45 (July) 1927.

10. Versé: München. med. Wchnschr. **63**:1047, 1916.

11. Hanssen: Klin. Monatsbl. f. Augenh. **61**:556, 1918.

12. Bachstetz: Wien. med. Wchnschr. **71**:1044, 1921; Ztschr. f. Augenh. **54**: 36, 1924.

13. Verhoeff, F. H.: Am. J. Ophth. **4**:155 (March) 1921.

14. Clapp: Tr. Am. Ophth. Soc. **27**:157, 1929.

15. Holloway and Fry: Tr. Am. Ophth. Soc. **27**:165, 1929.

soaps, and are possibly local reactions from hypercholesterolemia with additional activating stimuli. Following repeated paracentesis of the anterior chamber, Jess [16] was able to produce suggestive dotlike deposits, perhaps cholesterol or soaps, over the retina in rabbits on high cholesterol diets; his study did not include an analysis of the deposits. Sugita [17] was able to cause cholesterol deposits in the retina after hypercholesterolemia when an additional activating agent (phosphorus) was used. In the light of these experiments and clinical observations, it is not excessively speculative to assume that the highly refractile dots, the yellow excrescences and the warts seen with the ophthalmoscope may be local lipoid or lipoprotein deposits in many instances.

The macular degeneration of Batten,[18] "hereditary hyaline infiltration of the retina," or Doyne's [19] honeycomb family choroiditis was reported by Collins [20] as showing hyaline deposits near the disk and often in the macula between the retina and the choroid. The hereditary frequency of this lesion and its slow and relatively benign development suggest a familial metabolic disease; both attributes are commonly found in liporeticular disease. This syndrome usually is not progressive after loss of central vision has taken place. The usual age of onset is from 10 to 15 years. There is freedom from an associated mental deterioration. Leber [21] described the pathologic condition in the macula as a kind of tapetoretinal degeneration associated with colloid excrescences from the lamina vitrea, small, light yellowish or gray spots in the macula and peripapillary region. Another macular change (Tay's) occasionally seen in the adult without consequential loss of vision is that of yellowish or grayish spots with rounded borders and sometimes vague slight pigmentary changes. The senile exudative macular retinitis of Feingold,[22] the angio-exudative macular retinitis of Coppez and Danis,[23] and the "disciform degeneration of the macular lutea" of Junius and Kuhnt [24] seem to combine early exudative and late exudative and scar states on a common pathologic background. Holloway,[25] in 1927, under the title of "Angioid Streaks," gave a valuable general

16. Jess: Verhandl. d. deutsch. ophth. Gesellsch., 1925.
17. Sugita, Y.: Zentralbl. f. d. ges. Ophth. **9**:91, 1923.
18. Batten, T.: Tr. Ophth. Soc. U. Kingdom **17**:45, 1897.
19. Doyne, T.: Tr. Ophth. Soc. U. Kingdom **19**:71, 1899.
20. Collins: Ophthalmoscope **9**:577, 1913.
21. Leber: Netzhaut, in Graefe-Saemisch Handbuch der gesamten Augenheilkunde, ed. 2, Leipzig, W. Engelmann, 1916, vol. 7, pt. 2, p. 1204.
22. Feingold: Tr. Am. Ophth. Soc. **22**:268, 1924.
23. Coppez and Danis: Arch. d'opht. **42**:649, 1925.
24. Junius and Kuhnt: Die scheiben förmige Entartung der Netzhautmitte, Berlin, 1926.
25. Holloway, T.: Tr. Am. Ophth. Soc. **75**:173, 1927.

consideration of this subject in relation to associative vascular disease and mentioned its familial tendency. He made this statement:

> Some day . . . we shall know more concerning the various characters and methods of blood stream pollution, the manner of its neutralization or destruction, and, finally, the disposition of the residue with the final effect such elimination may have on the tissues concerned. On the other hand, we shall know more concerning the direct effect of the pollution on the tissues generally, and the vascular system itself.

In this connection, a report by Holloway and Verhoeff [26] is interesting. The right eye in one of their patients (case 8), examined after section, showed a macular connective tissue mass between the retina and the choroid. At the margins of the mass were collections of swollen transparent cells filled with fine granules; these were described as "certainly pigment cells which had undergone fatty degeneration." The so-called pigment cells, however, may represent reticular cells and the fibrous plaque the usual late or older stage of the process. Unfortunately, no fat stains were reported. A similar area of fibrous proliferation was found adjacent to the nerve head. Excrescences, of the type commonly found in the eyes of the aged, were seen on Bruch's membrane in both eyes, and on Descemet's membrane in the right eye. The anterior segment of the left eye was not described.

The ocular lesion in amaurotic family idiocy (Tay-Sachs) was described by Pick and Bielschowsky [27] as a manifestation of a lipoid metabolism disease. An association with Gaucher's syndrome was mentioned by Bloom.[28] This syndrome is familial and largely racial. The typical picture seen with the ophthalmoscope in the infant is a diffuse milky-colored macular area with a red foveal spot. Like other lipoid disease reactions in the very young, it is rapidly progressive. The older juvenile form is familial and much slower in development, but closely related pathologically to the infantile form. Sections through the macular area show swollen foamy cells, apparently storing lipoids.

The microscopic senile changes and vascular sclerosis in the retina were well described by Friedenwald.[29] An ophthalmoscopic and microscopic study of the retina illustrates the interplay between vascular and metabolic disease, exudation and hemorrhage, fat and pigment changes.

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26. Holloway, T., and Verhoeff, F. H.: Disklike Degeneration of the Macula with Microscopic Report Concerning a Tumor-Like Mass in the Macular Region, Tr. Am. Ophth. Soc. **26**:206, 1928.

27. Pick and Bielschowsky: Ueber lipoidzellige Splenomegalie (Ty. Niemann-Pick) und amaurotische Idiotie, Klin. Wchnschr. **6**:1631, 1927.

28. Bloom: Splenomegaly (Type Gaucher) and Lipoid Histiocytosis (Type Niemann), Am. J. Path. **1**:595 (Nov.) 1925.

29. Friedenwald, J. S.: The Pathology of the Eye, New York, Macmillan Company, 1929, p. 168.

It is important that cholesterol crystals and deposits of lipoids can frequently be demonstrated to be part of retinal disease, including the albuminuric and diabetic kinds; these substances are especially deposited in the aging process. The circulating lipoids in the blood plasma or in a local tissue are innocent unless they act long enough to stimulate certain cells or unless they act with other stimuli. In so-called lipemia retinalis, the percentage of circulating fat may be high enough to cause the blood vessels to appear milky, but retinal lesions do not develop. But a low percentage of circulating lipoids with arteriosclerosis or sclerosis and hemorrhage may show considerable exudative and storage abnormalities, as in albuminuric and exudative retinitis. It is probable that arteriosclerosis is partly a lipoid disease. An association between lipemia retinalis and xanthoma has been noted.

In Coat's massive retinitis and von Hippel's disease of the retina the associative cystic lesions in the kidneys and pancreas, often with xanthomatic fluid and cholesterol, and tumor of the spleen, cartilages, suprarenals and central nervous system were correlated by Lindau [30] and noted to be present in about 21 per cent of reported cases. Collins [31] first accurately studied microscopically the lesion in the eye and described it as "a capillary nevus which in places had undergone cystic degeneration." This disease has been found to have familial tendencies and to be very slow in developing. The vascular involvement in the retina is currently assumed to be primary and the exudative process secondary. This may be true only so far as the grosser pathologic changes are concerned. The stage of massive exudation (Coat's type) appears late, but is more destructive in the eye than are vascular changes alone. Both the exudation and the vascular changes have been noted to disappear, leaving fair vision in spite of pigmentary deposits in the retina (Friedenwald,[32] Benedict [33]).

An interesting grouping of clinical observations and possibly a definite syndrome is that of keratoconus, hemosiderin ring [34] in the cornea, familial tendency and rarefaction of the parietal bones.[35] Wernicke [36] suggested that keratoconus is a systemic disease affecting the connective tissue.

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30. Lindau: Acta path. et microbiol. Scandinav., 1926, supp. 1, p. 1; Acta ophth. **4**:193, 1927.

31. Collins: Tr. Ophth. Soc. U. Kingdom **19**:141, 1894.

32. Friedenwald and Friedenwald: Terminal Stage in a Case of Retinitis with Massive Exudation, Tr. Am. Ophth. Soc. **27**:1929.

33. Benedict, in discussion on Friedenwald (footnote 32).

34. Fleisher: Arch. f. Augenh. **73**:242, 1913; **68**:41, 1913.

35. Török and Redway: Tr. Am. Ophth. Soc. **75**:123, 1927.

36. Wernicke, O.: Semana méd. **28**:693 (June 16) 1921.

COMMENT

Reflection on the few clinical syndromes mentioned suggests certain similarities and constitutional and familial tendencies; the diseases are emphasized by exudates or deposits. In the young, the disease process is active and diffuse; in the old, it is less active and more circumscribed. It is difficult to separate the degenerative processes from deposits. Degenerations may lead to deposits, but deposits are not necessarily signs of degeneration, although apparently the two conditions may be present in the same lesion. Future studies, especially of retinal storage of pigments, may show one of several types of so-called glial cells mainly involved in this process. The temptation exists to speak of deposits in the intermediate metabolic tissue as lipoid, calcium or pigment gouts. The importance of the diffuse connective tissue (Maximow [37]) in general and in local defense mechanisms, nutrition, water exchange, hematopoiesis or internal secretions is more than suggestive and furnishes a hypothetic common basis for many obscure disease manifestations in the eye. The whole range of liporeticular disease constitutes a medical play in which one character may wear many masks or assume many rôles. The unknown hand in this play is the activating agent. Certainly it concerns the chemical changes of the aging process. Experimentally, it may be trauma, infection or a chemical. Practically, we have a new approach to some old problems.

SUMMARY

In two examples of a rare syndrome, exophthalmos was produced by pressure and loss of bony support at the apex of the orbit. It is suggested that some ocular signs and syndromes be considered chiefly as reactions from a metabolic disease. The common pathologic basis concerns the wide-flung reticular tissue and its reactions at different ages to various lipoids. This suggestion provides a new basis for understanding and for combining certain ocular syndromes and also a method of classification for future study.

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ABSTRACT OF DISCUSSION

DR. E. C. ELLETT, Memphis, Tenn: Ophthalmologists will find that the interesting cases reported concern them only incidentally, one might say accidentally, for the only ocular symptom, the exophthalmos, is not an essential feature of the disease but appears only because the bony walls of the apex of the orbit are affected, or because xanthoma masses are deposited in the orbit. The other features of the disease overshadow ocular symptoms, though the exophthalmos may be a prominent and serious complication, necessitating some such measure as tarsor-

37. Maximow: General Review: Morphology of the Mesenchymal Reactions, Arch. Path. 4:557 (Oct.) 1927.

raphy to prevent the loss of the eye by corneal ulceration. Since the discovery of the reticulo-endothelial system fourteen years ago by Aschoff, Landau and Kiyono, the number of papers referring to it have been large and its importance in various pathologic conditions seems great. This tissue is widespread in the body. Some think that the capillary endothelium, as well as the reticulum cells of the thymus and the glia cells of the central nervous tissue, is part of this system. It lines the lymph spaces of the thyroid and parathyroid glands and is found in the suprarenals. Much concerning this system or tissue is still unsettled and under discussion. Under various pathologic conditions the cells of the system may act as phagocytes of the red blood cells, the cells that line the vascular spaces being especially concerned in this process. This action is due to increased functional activity of the reticulo-endothelium, for instance, due to anemia, to stimulation of them by bacterial toxins in certain infections or to some changes in the red cells themselves making them liable to phagocytosis. The reticulo-endothelial cells then store up the iron liberated by the red cells; they also have a great affinity for lipoids, which they also store up when they are made susceptible to this phagocytic action as a result of the local resorption of fat, or of a disturbed fat metabolism. As the spleen contains most of these histocytes, it has been suggested that the spleen be removed when there is increased destruction of red cells by the histiocytes. They may be stimulated to greater activity by x-rays or by foreign protein therapy. The nomenclature of eye diseases is open to many criticisms. If ophthalmologists had to do it over, one cannot imagine that such words as "cataract" and "glaucoma" would ever be used to designate the conditions with which these names are identified. In some instances the misfit of the name is so apparent as to be rapidly going into the discard. In the case of fundus lesions, a name is often applied in a descriptive rather than in a pathologic or causal sense, such as "retinitis circinata," "retinitis punctata albescens;" even worse, a condition may be called by a man's name, such as "Gunn's dots," or "Coates' disease," and sometimes by different names in different countries, such as "Hippel's disease" and "Lindau's disease." The relation of the lipoids and their behavior to questions of diet and the relation of their storage and deposit in various places to local irritation, such as trauma, to local, disease, such as local vascular disease, or to local effects of general diseases, such as diabetes, hypertension and nephritis, explain why they are manifest in some persons and localities and not in others. The thought that the same thing underlies many familial and hereditary conditions deserves earnest consideration. The fact that an author is not ready to put into concrete form a scheme of reclassification of fundus conditions and general diseases with fundus or other ocular manifestations is evidence that the subject is extremely difficult and that at this stage we are only invited to consider the proposal.

DR. LAURA A. LANE, Minneapolis: I probably misunderstood Dr. Heath, but I thought he said that nothing had been done on the reticulo-endothelial system in the eye. I recently worked on this and found in the literature about eight or ten references to the reticulo-endothelial system as it pertains to the eye. The latest work, which is quite extensive, has been done by three or four Italian workers. In the *Annali di ottalmologia* of last year, the year before and one or two years previous, there are reports and valuable illustrations showing the parts of the eye in which the histiocytes are found. The Japanese also have contributed several articles. It occurs to me that the Kaiser-Fleischer ring in Wilson's disease, which is a rare condition, may have something to do with the reticulo-endothelial system of the eye.

DR. ARTHUR J. BEDELL, Albany, N. Y.: I have demonstrated the photographic history in a case of angiomatosis retinae. The first picture illustrated the large and tortuous veins about the disk. The second showed that at the end of a month there was a very slight increase in the fulness of the vessel. Fifteen months later, the disk outline was completely lost, with a thick macular exudate of radiating spokes. In the temporal region the retina was detached and an angioma had developed. The last pictures demonstrated the progress of the exudate as it extended from one landmark vein to another. In the short period of three weeks another angioma had also formed and was photographed as a peculiar white elevated mass into which an artery passed and from which a distended vein emerged. So far as I know there has been no photographic history of such a case. As I have seen four patients with angiomatosis in the last two years, I feel that it must be somewhat more common than the literature suggests.

DR. PARKER HEATH, Detroit: I did not knowingly say there were no references to a reticular system in ophthalmic literature, but so far as I know there is no reference to the Schiller-Christian syndrome. The Italians are doing some interesting work along this line, and some of it has been published. Dr. Bedell's fascinating and valuable presentation of angioma lesions in the retina shows photography to be one of the best tools for the study of exudative changes. We have been led to believe that there may be discrete angioma lesions and scattered multiplying lesions such as are shown by Dr. Bedell's photographs. In the discrete form it is possible that most of the destruction is from the massive exudate and not from the comparatively small lesion.

SECONDARY GLAUCOMA WITH DETACHED RETINA IN BOTH EYES*

WILLIAM H. WILDER, M.D.
CHICAGO

The coincidence of secondary glaucoma and detached retina in the same patient is so infrequent, and the features of the case are so unusual that I venture to present this subject for the consideration of the Society.

REPORT OF CASE

Clinical History.—Z. R. S., a business man, aged 42, was first seen by me on May 31, 1929. He stated that for years he had worn glasses to correct myopia and astigmatism. He had consulted Dr. Bruns of New Orleans in March, 1928, who had changed his glasses, and aside from his refractive error had found nothing abnormal.

He consulted Dr. Bruns again on Feb. 25, 1929, for a reexamination, and at this time it was discovered that he had glaucoma in each eye. Later, Dr. Bruns sent me a letter confirming this statement with a transcript of his notes of the examination. Vision in the right eye with —2.75 sphere, —1.75 cylinder was 20/20; in the left eye, with —3.00 sphere, —1.75 cylinder, 20/20. With the ophthalmoscope he noted a slight conus at the lower part of each optic disk and a rather deep physiologic cup, which he thought seemed deeper and more suggestive than it had been one year before. At an examination a few days later he found the fields for white normal, and no scotomas or enlargement of the blind spots. The patient was color blind for red and green. He noted slight anesthesia of the cornea. In the right eye, tension with the Schiötz tonometer was 40 mm.; in the left eye, 40 mm. Dr. Bruns prescribed pilocarpine, 1 per cent three times a day, and strongly recommended operation, preferably trephining.

Hoping to avoid this, on March 1, 1929, the patient consulted Dr. Blum of New Orleans, who sent me the history of the case while the patient was under his care. Dr. Blum found increased tension in both eyes, and central vision as follows: Vision in the right eye with —2.75 sphere, —1.75 cylinder, axis 180 was 18/20; in the left eye with —3 sphere, —1.75 cylinder, axis 180, 18/20. He observed a small myopic conus and with the corneal microscope, considerable pigment dust on the posterior surface of the cornea. Physical examination by Dr. Sidney K. Simon showed a possible potential tuberculous process in the lungs, a moderate degree of intestinal toxemia, resulting from stasis, nothing wrong with the blood chemistry, and no marked pathologic changes in the abdomen.

Some teeth were defective, and the extraction of two had been followed by such considerable hemorrhage that Dr. Blum refrained from having any more extracted at that time. He ordered 2 per cent pilocarpine ointment and also pilocarpine solution to be dropped into the eyes, and instructed the patient in the use of digital massage of the eye. He states that the patient overdid this.

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* Submitted for publication, July 30, 1930.

* Read at a Meeting of the American Ophthalmological Society, Hot Springs, Va., June 2, 1930.

One evening early in April the patient noticed small black particles flashing before the right eye and some distortion and blurring of vision. Dr. Blum writes: "My first thought was of fresh uveitis, and I believed this was the cause until I dilated with cocaine and was surprised to find far out in the temporal periphery a small process which resembled a retinitis proliferans. This spot was surrounded by a red border which suggested the possibility of a hemorrhage and that the floating body in the vitreous was a blood clot. Two days later another examination showed a definite detachment of the retina in the nasal periphery with a smaller area of detachment in the temporal quadrant."

The patient was kept absolutely quiet in bed for five weeks, during which time the tension of the right eye became normal part of the time, and the retina became partly reattached. The field of vision of the right eye showed characteristic contraction in the upper half (chart 1). He left the hospital at the end of five weeks to return to his home in Chicago, and Dr. Blum referred him to me

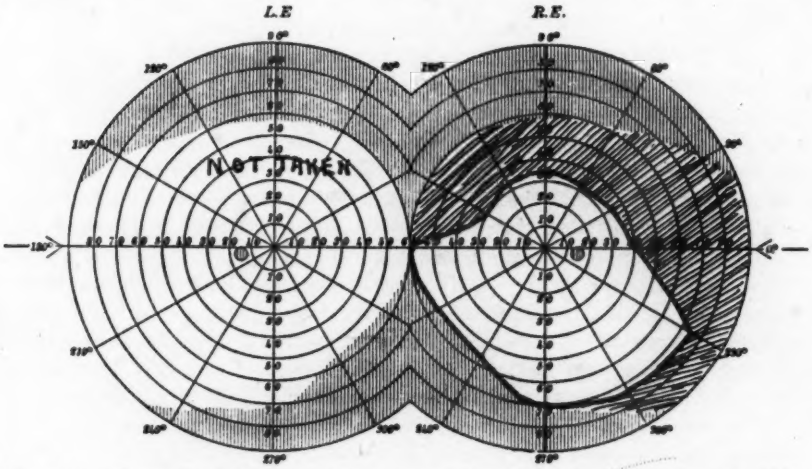

Chart 1.—Copy of field of right eye taken by Dr. Blum on May 29, 1929.

with the query: "Should something surgical be done for the detachment now, or should we wait until the general condition is improved?"

When I first saw him, vision in the right eye was 20/20; in the left eye, 20/30, with his correcting myopic glasses. He had been using 1 per cent pilocarpine drops and 2 per cent pilocarpine ointment. The right pupil measured 3.5 mm.; the left, 3 mm. Tension in the right eye was 31 mm.; in the left, 41 mm. (Schiötz). The fields were as shown in chart 2.

On the next day, June 1, after the repeated use of pilocarpine, the tension in the right eye was 15 mm.; in the left eye, 38 mm. One per cent eucatropine was instilled three times for the purpose of dilatation. After one hour the right pupil measured 5 mm.; the left pupil, 6 mm. Tension in the right eye was 22 mm.; in the left eye, 44 mm.

Ophthalmoscopic Examination.—The media of the right eye appeared clear, but with the corneal microscope considerable pigment dust could be seen on the posterior surface of the cornea. A flat detachment of the retina of from 4 to 5 diopters at the highest point was seen in the nasal quadrant extending from the periphery half way to the disk. In the temporal periphery, at about 8 o'clock, was seen an area of approximately 2 or 3 optic disks in which the

choroid showed a few atrophic patches together with irregular pigmentation. There was no evidence of any detachment of the retina over this area, nor of the appearance of retinitis proliferans mentioned by Dr. Blum, but it is possible that there may have been a hemorrhage accompanied by a slight detachment to account for the peculiar pigmentation of the area.

The right optic disk showed a rather large, shallow, physiologic cupping and a narrow crescentic conus on the inferior temporal side.

The left media were clear, except that here also the slit-lamp revealed fine pigment dust on the posterior corneal surface. The disk presented a shallow glaucoma cupping and pulsation of the inferior retinal vein. Very light pressure caused an arterial pulse. At this time there was no sign of detachment of the retina in this eye.

Transillumination with the Zeiss instrument gave a uniform pupil glow in all fields in the two eyes.

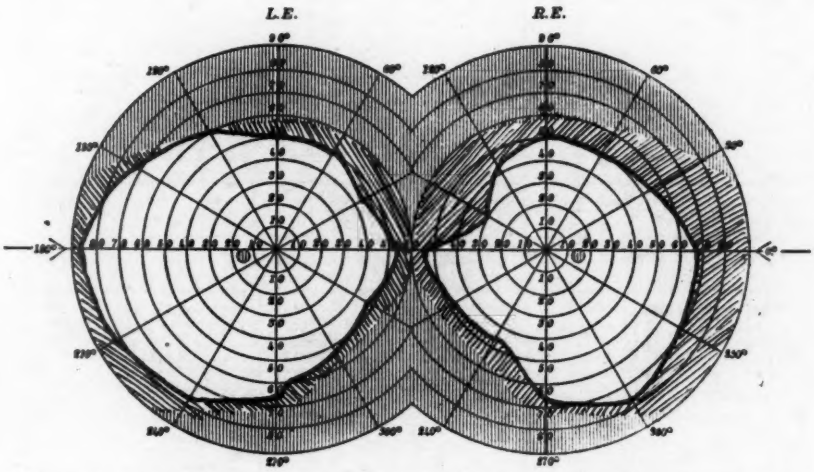

Chart 2.—Fields taken on May 31, 1929, a hazy day, with a target of 1 cm., at a distance of 33 cm. No color fields; patient is red-green blind.

Physostigmine (eserine) was then used twice, causing good miosis, and the patient was advised to continue the use of 1 per cent pilocarpine solution regularly, but to omit it the morning of the day of his next visit, June 3. On this visit each pupil was dilated to 5 mm. (although he had observed that they were very small the night before), and tension in the right eye was 30 mm.; in the left eye, 47 mm. (Schiötz).

Course.—During my absence for two weeks the patient was under the care of my associate, Dr. Thomas D. Allen, who was called to the patient's home on June 4 to find him very nervous, fearing that he was going blind. He had no pain, the pupils were small, and the tension in each eye was 18 mm. (Schiötz). The patient was reassured, given a sedative and told to continue the use of pilocarpine regularly six times daily.

On June 6, at the office, the pupils measured 4 mm. Tension in the right eye was 27 mm.; in the left eye, 45 mm. Dr. Allen suggested operation, but the patient demurred, and he was sent to see Dr. H. Gradle in consultation. Dr. Gradle found the anterior chamber of normal depth, fine pigment dust on the posterior surface of both corneas, the pupils well contracted, measuring less than

2 mm. two hours after the administration of pilocarpine, and tension in the right eye 20, in the left eye, 30 (Schiötz). The pupils were too small for Dr. Gradle to get a satisfactory view of the detached retina, and the disks, which were indistinctly seen, presented a flat excavation that he thought was not pathologic. He advised hospitalization so that the tension could be measured four or five times daily, both with and without miotics of varying strength and frequency.

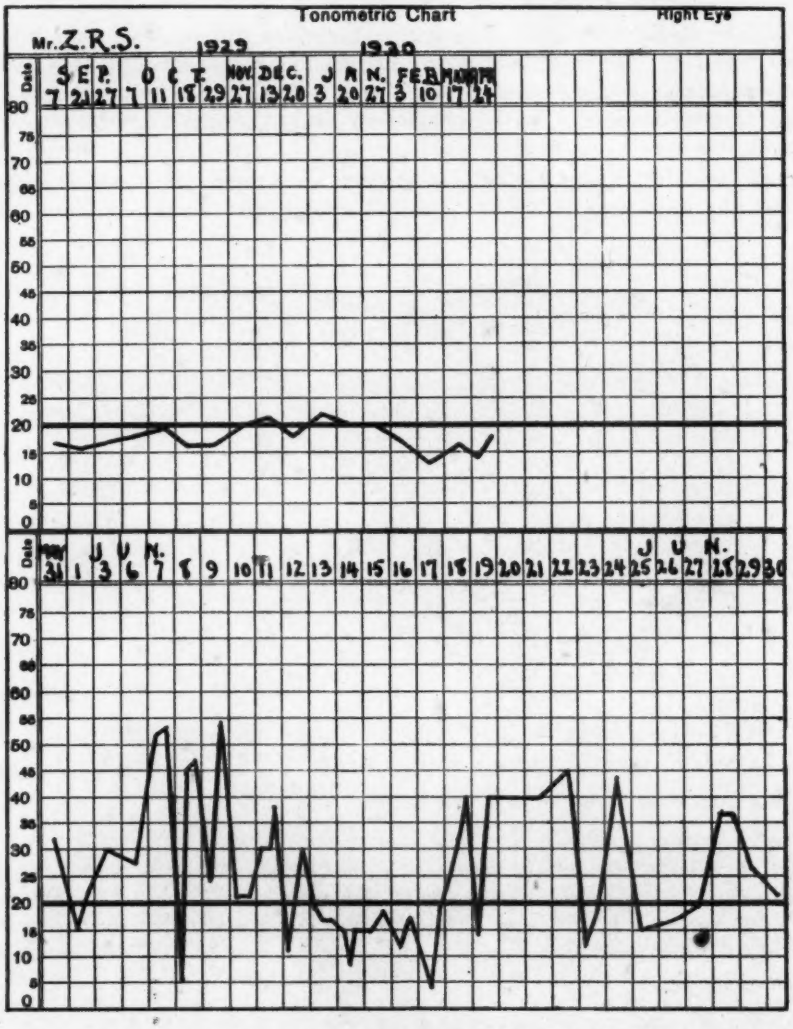

Chart 3.—Tonometric chart for right eye from Sept. 7, 1929, to June 30, 1930. (In charts 3 and 4 note that the lower part of the chart records the tension of the earlier history and the upper part, that of the latter history of the case.)

Dr. Gradle suggested trial of levoglaucosan (an epinephrine substitute) if the tension was not controlled with pilocarpine. The patient entered Presbyterian Hospital on June 7. That evening examination showed the tension in the right eye 44 mm.; in the left eye, 51 mm. Four hours later the tension was: right eye, 53 mm.; left eye, 62 mm. No pilocarpine had been used that day, and

the pupils measured about 4 mm. The patient was given paraldehyde for sleep, and had a good night's rest.

The next morning the pupils measured 3 mm. Tension in the right eye was 12; in the left, 5 mm.

The patient was kept in bed continuously for the next three weeks, the tension being taken three times daily, sometimes oftener, for the first week, during which

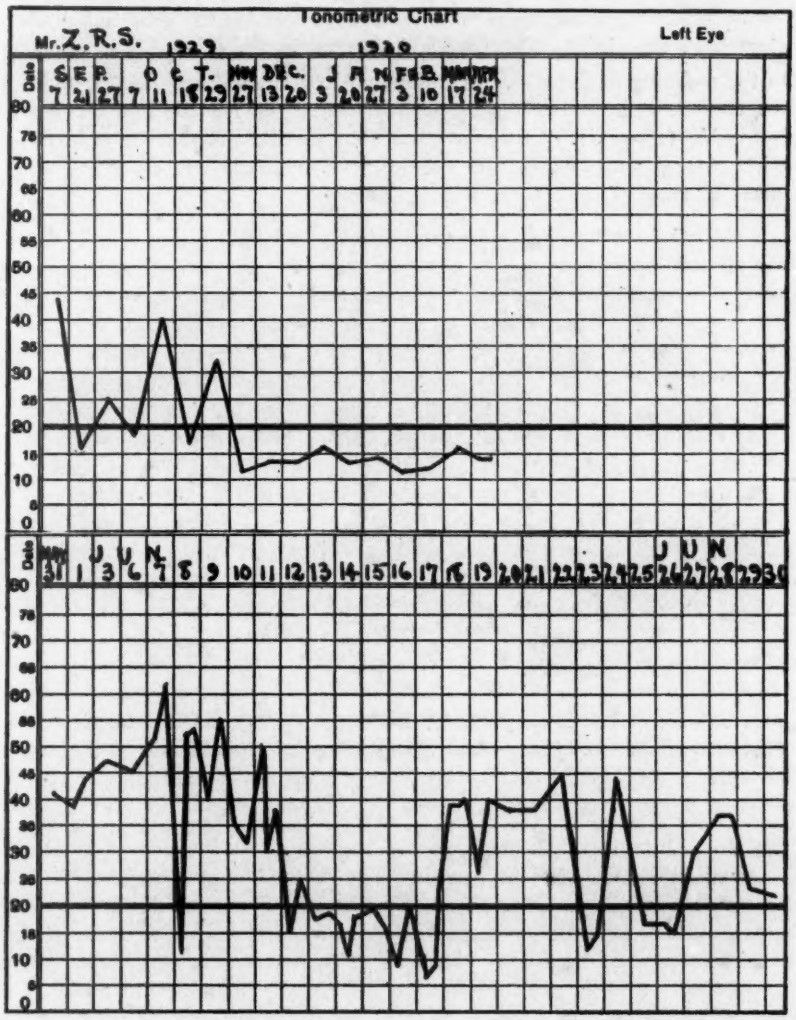

Chart 4.—Tonometric chart for left eye from Sept. 7, 1929, to June 30, 1930.

time the tension ranged above normal, usually lower in the morning and higher in the afternoon, that in the right eye usually being lower than that in the left (charts 3 and 4). After four days, levoglaucosan was dropped into the eyes once daily with the effect that the pupils were dilated, and after a few days the tension was distinctly lowered (charts 3 and 4) for several days to 20 mm. or below.

On June 15, examination showed the detachment somewhat flatter, not over 6 diopters at the highest point. A small rent in the retina was seen at the extreme periphery over the area of choroiditis at about 8 o'clock. The patient was again seen in consultation by Dr. Gradle, who advised no operation, and to substitute pilocarpine 1 or 2 per cent for the glaucosan. After once lowering the tension with glaucosan, pilocarpine given three times a day seemed to keep it very low, at one time down to 5 and 9 mm. In spite of this, on June 18 the tension again rose to 35 mm. in the right eye and 37 mm. in the left, to drop again the next morning to 14 mm. in the right eye and 26 mm. in the left.

On the morning of June 19, the patient noticed a black area in the upper nasal field of the left eye similar to that he had had in the right eye at the beginning of his trouble (chart 5). Examination at that time showed: Vision in the right eye with glasses was 20/30+; in the left eye with glasses, 20/30. The pupils measured 3.5 mm.

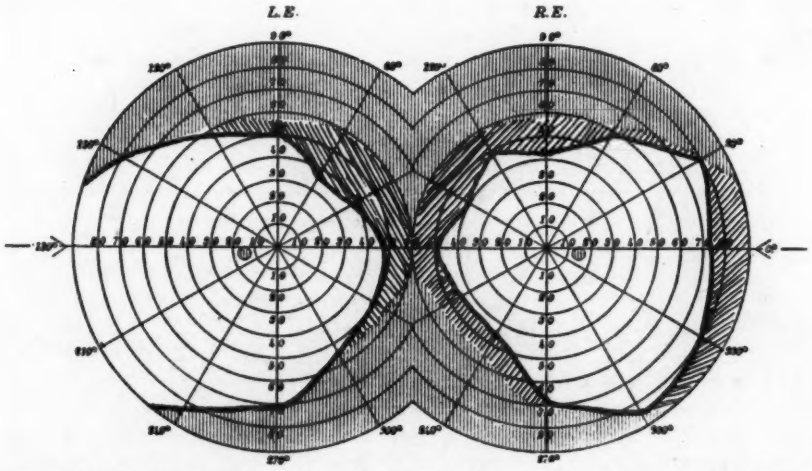

Chart 5.—Fields taken on June 19, 1929, a hazy day, with a target of 1 cm., at a distance of 33 cm. There was a beginning of detachment of the retina in the left eye.

With the ophthalmoscope the right eye showed in the vitreous a large cloudy area, noticed subjectively by the patient. The retina was still detached as before. In the left eye there was beginning detachment of the retina in the inferior temporal quadrant with some pigmentary disturbance in the extreme periphery in the neighborhood of from 5 to 6 o'clock. This detachment was not as extensive as that in the right eye, and measured at its highest point no more than 4 or 5 diopters. The patient was not told of this misfortune for fear of unnerving him; indeed it took careful diplomatic evasion to disarm his suspicion. However, his mother and other members of his family were informed of the serious condition.

He was kept on his back, and given yellow mercurous iodide, explained to him as necessary for the cloudy vitreous of the right eye, but in reality for the choroiditis and detachment of the retina of the left eye.

A general examination made by Dr. Donald Abbott of the Presbyterian Hospital had brought out that in addition to the usual children's diseases, measles, scarlet fever and chickenpox, he had had diphtheria, typhoid fever and three attacks of influenza in his youth. The last attack of influenza had left a chronic

sore throat with some postnasal dicharge. Examination showed a mild chronic tonsillitis, nasopharyngitis and a questionable abscess at the apex of one tooth.

Laboratory tests of the blood gave practically negative results: red cells, 4,650,000; hemoglobin, 83 per cent; white cells, 7,400. The blood pressure was 108 systolic and 70 diastolic. The coagulation time was four and one-half minutes. Roentgen examination of the chest showed some scoliosis of the upper dorsal spine and slight thickening of the pleura at each apex.

About June 29, the suspicious upper molar tooth was extracted after tests again showed the coagulation time to be normal, and a few doses of fibrinogen had been given. No unusual bleeding occurred.

As the tension still continued high notwithstanding the continued rest in bed and the regular use of pilocarpine, on July 2 I performed iridencleisis on the right eye under a large conjunctival flap, making an iridotomy through the sphincter pupillae on one side of the prolapsed iris. No accidents occurred during the operation, but there was a very slight amount of blood in the anterior chamber which I thought had entered from the conjunctival wound. The following day, at the time of the first dressing, more blood was noticed, and this increased gradually until in a few days the anterior chamber was entirely filled. Furthermore, it seemed that considerable hemorrhage had occurred in the vitreous chamber, for the patient could not perceive strong light. There was no pain. The tonometer was not used, but although to my fingers the tension seemed increased it did not seem higher than it had been before the operation.

The patient was kept quiet in bed, and various customary measures to promote absorption of blood from the eye were used. In two weeks the anterior chamber was comparatively clear, but there was no red pupil reflex and no light perception. Tension seemed normal.

Gradually the vitreous began to clear, and in two weeks more he could perceive light and a slight red reflex was obtainable.

On August 15, six weeks after the operation, the patient had a foggy vision of 20/40, and a good view of the fundus could be obtained through some floating vitreous clouds. No sign of the detachment could be seen. The left eye, which had been treated regularly five times daily with pilocarpine, was dilated with glaucosan, and no evidence of detachment was seen in it.

He was allowed to get out of bed and move about a little. Tension taken at intervals showed that of the right eye always well within normal; that of the left, always increased. On August 27, after eighty-one days in the hospital, he was allowed to go home.

At that time vision with glasses was 20/30+ in the right eye and 20/30+ in the left eye. Tension in the right eye was 16 mm.; in the left eye, 50 mm. There were a few fine vitreous opacities in the right eye. The fields were not materially different from those taken before. He was to have pilocarpine six times daily in the left eye and to report at the office two or three times weekly.

On September 7, vision in the right eye with —3.25 sphere, —1.50 cylinder, axis 170 was 20/20+; in the left eye with —3.25 sphere, —2.00 cylinder, axis 170, 20/20. Tension in the right eye was 17 mm.; in the left eye, 44 mm. From this time on the tension of the left eye varied, sometimes being well within normal and at times up to 50 mm.

On October 7, tension was 18 mm. in the two eyes.

On October 11, after the test with homatropine in each eye, the tension in the right eye was 20 mm., and in the left eye, 40 mm. Careful examination failed to reveal any detachment in either eye, but around the site of the old detachment in each eye was seen some pigment disturbance. The patient complained of a

peculiar photopsia in the upper field of each eye corresponding to the blind area shown in the chart. This he described as a fluttering and a dark flashing as of dull flames through a heavy field of smoke. This symptom, which always appeared on moving the eye quickly from side to side, had been noticed from the beginning of his trouble and had persisted to the time of writing. I have ascribed it to dragging on strands of adhesion between the retina and the choroid with movements of the degenerated vitreous body.

The patient was seen at regular intervals, but it was evident that the miotic did not control the tension of the left eye; sometimes the tension was well within normal, but more frequently was considerably above.

As the left disk seemed to show increased cupping, I advised operation on that eye. On November 11, the patient again entered the hospital. He had been receiving calcium lactate, 5 grains (0.324 Gm.) three times a day, for some days previously. Examination of the blood showed normal coagulation time.

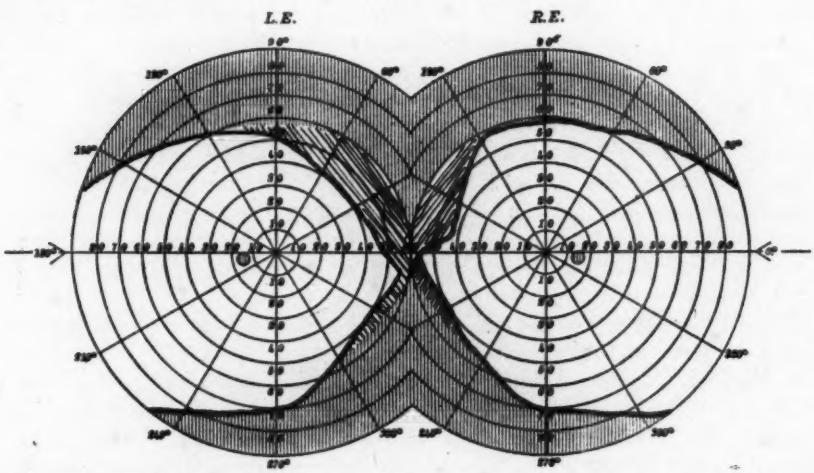

Chart 6.—Fields taken on Aug. 29, 1929, with a target of 1 cm., at a distance of 33 cm.

On November 12, iridencleisis was performed on the left eye in the same manner as that done on the right eye with iridotomy of sphincter border of the iris. Very slight hemorrhage occurred into the anterior chamber, which was gently irrigated. For a few days the chamber was clear, but on the sixth day, after removal of the one suture in the conjunctival flap, there was a slight recurrence of hemorrhage into the anterior chamber. This was absorbed in a few days, and uneventful recovery followed, the patient leaving the hospital on November 25, the use of pilocarpine having been discontinued.

Since that time he has been observed frequently, and at every examination the tension was low, that of the left eye usually less than that of the right. Indeed it was apparent that the left eye was draining more freely than the right, a fact that was also observed by the patient himself, who, noticing the edematous appearance of the conjunctiva, particularly in the afternoon, stated that it seemed to him that the eye was watering and tearing.

The last examination, made on April 24, 1930, showed: vision in the right eye with —3.00 sphere, —1.50 cylinder, axis 170, 20/20+; tension, 14 mm.; vision in the left eye with —3.00 sphere, —1.75 cylinder, axis 165, 20/30+; tension, 14 mm.

After good dilatation of both eyes with 1 drop of 2 per cent homatropine, examination showed one small postsynechia at 3 o'clock in the left eye.

The corneal microscope showed in both eyes some pigment dust on the posterior surface of the cornea. No detachment of the retina or any tear in the retina could be seen. There seemed to be less pigment in the choroid and retina than

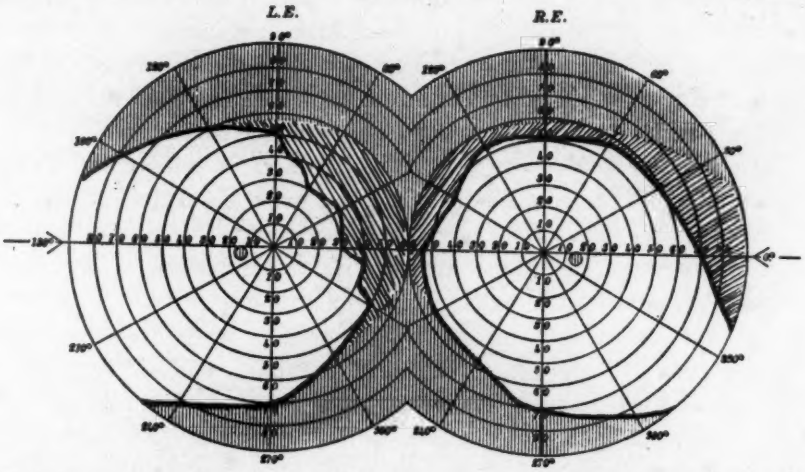

Chart 7.—Fields taken on Dec. 9, 1929, in dull daylight, with a target of 1 cm. at a distance of 33 cm.

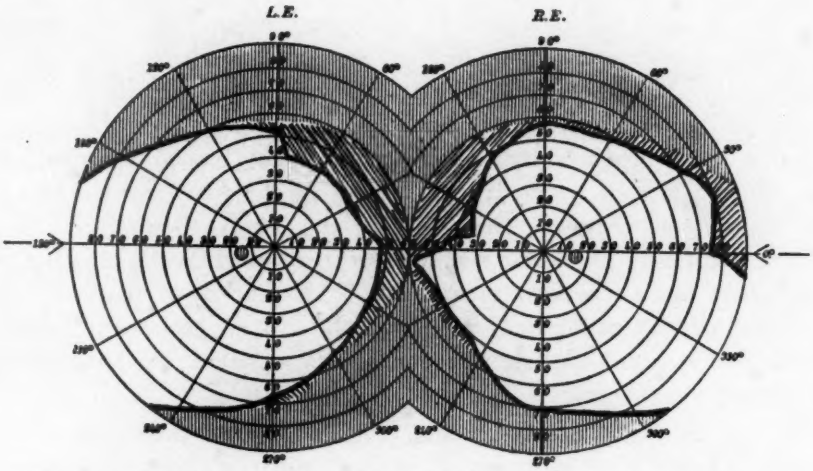

Chart 8.—Fields taken on April 24, 1930, in daylight, with a target of 1 cm., at a distance of 33 cm.

had been observed in earlier examinations. The upper portions of the form fields still showed the same defect as before. After the mydriatic had been given, tension in the right eye was 18 mm.; in the left eye, 14 mm. The patient still complained of a fluttering and a dull flashing in the extreme upper fields of each eye on movement especially to either side.

COMMENT

A study of this case arouses some interesting reflections on the etiology of glaucoma as well as on that of detachment of the retina.

In the first place, the discovery of pigment dust in the anterior chamber and the presence of a choroidal lesion in the extreme periphery place this case in the category of secondary glaucoma. The history, progress and absence of any evidence of intra-ocular growth or mass of hemorrhage as shown by transillumination rule out the idea of hypertension produced mechanically as by the presence of a tumor.

They seem to speak more for the biochemical or inflammatory origin of the trouble. The uveal disturbance was very slight and might easily have been overlooked. It suggests that many of the cases of so-called simple or noncongestive glaucoma may be of similar origin, viz., a low grade uveitis, eluding the most careful examination.

It should be recognized that the boundary lines of primary and secondary forms of glaucoma frequently overlap. It may be that many cases regarded as primary glaucoma will, by more careful and more refined study, prove to be secondary in the sense that the principal sign of the condition, increased intra-ocular pressure, is secondary to underlying conditions, either mechanical or biochemical, that help to bring it about.

It seems to me that a case such as this gives support to the idea that the problem of glaucoma is something more than an anatomic condition of interference with the outflow of fluids from the eye. It involves as well the question of the inflow and the mechanism of the formation of the intra-ocular fluids as well as the nature of them. It would seem probable that an irritative factor like an inflammation even of low degree would affect such a mechanism and would also alter the physicochemical character of the fluids themselves. Such cases of secondary glaucoma would seem to support the theory that the intra-ocular fluids (aqueous) originate by a process of dialysis from the blood of the capillaries chiefly of the ciliary processes, possibly also of the iris and the anterior choroid as advanced by Duke-Elder, Hamburger and others.

The permeability of the capillary walls may be increased by the irritation of the toxic elements of the inflammation, thus allowing not only the serum but the colloid elements of the blood plasma to enter the eye, as demonstrated by Krogh and others.

This case of secondary glaucoma, like others of a similar nature, suggests that an unusual outflow of fluids from the capillaries with abnormally permeable walls was more than the exits of the eye could take care of, and continued hypertension resulted. The filtration angle was not blocked by the root of the iris, for the anterior chamber was

not shallow, but of good depth. Probably the colloid substances in the escaped fluids helped to clog the spaces of Fontana and contributed to the result.

Although the tension of the eyes still remains normal after operation, it would seem from the unusually edematous condition of the conjunctiva of the left eye that the underlying condition persists, viz., abnormally permeable capillary walls that allow an excess of fluid to escape into the eye. Fortunately, up to the time of writing this is well taken care of by the filtering cicatrix. The efficiency of this filtration may have helped greatly in the clearing of the vitreous after the serious postoperative hemorrhage.

As to the detachment of the retina in this case, it would seem to be explained by the excessive amount of highly albuminous fluid that escaped beneath the retina from the capillaries of the choroid at the site of the inflammation in that structure.

According to the mechanical theory, in myopia there is a tendency to shrinking of the vitreous and elongation of the globe. The inelastic retina is pulled up from its bed by the separation of its two fixed points of attachment, the optic disk and the ora serrata. A tear in the retina, frequently near the ora serrata, may occur because of the traction, and the detachment is increased by the fluid portion of the vitreous entering into the subretinal space through this hole. It is assumed that there is a deficiency of aqueous fluid to account for the decreased intra-ocular pressure that is usually observed in such cases.

A study of this case seems to indicate that the detachment was caused by the great outflow of fluid from the choroid that did not diffuse through the retina, but, by forcing it up, caused a tear at the site of a recent lesion in the choroid to which the retina was attached. It must be remembered that this occurred in eyes that were not highly myopic, the vitreous of which did not show visible signs of degeneration or shrinking.

THE EYE IN THE TUBERCULOUS PATIENT*

MICHAEL GOLDENBURG, M.D.
AND
NOAH D. FABRICANT, M.D.
CHICAGO

The ease with which it is possible to make a diagnosis of tuberculosis in an otherwise obscure ocular lesion probably accounts for the vast literature accumulated on this subject since Pirquet first called attention to his now famous skin reactions. In years gone by, a group of symptoms of which the etiology was unknown was referred to clinically as an idiopathic disease. The terms idiopathic, scrofulous and strumous, and the various diatheses are no longer encountered with the same degree of frequency in the literature. Instead, there is an assortment of skin reactions for this, that or the other form of protein, specific or nonspecific, which possess the added aura of laboratory prestige and its consequent impressiveness. That a patient may for many years show a positive Widal reaction is no reason for attributing every obscure symptom or lesion to his previous typhoid infection, and the same may be said of many similar reactions.

This is not an attempt to underestimate laboratory procedure in any way, but a serious effort to find a reasonable medium between these values and clinical observation.

Two and a half years ago, through an appointment as ophthalmologist to the Municipal Tuberculosis Sanitarium of Chicago, one of us (M. G.) was afforded the opportunity of studying pathologic conditions of the eye in a large number of tuberculous subjects. During this time we saw a great many cases of tuberculosis in various forms and stages, but the comparatively rare observation of what might be termed a tuberculous eye lesion was most discouraging. We could offer no reasonable explanation for this peculiar state, in view of the fact that during a service of more than twenty years (that of M. G.) at the Illinois Eye and Ear Infirmary, cases were not infrequently seen which we were willing to label as due to the tubercle bacillus or its toxins. This experience is common to most observers working in a field in which the clinical material is abundant. It was therefore difficult to accept the

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* From the Department of Ophthalmology, City of Chicago Municipal Tuberculosis Sanitarium.

statement so frequently made that "eye lesions in pulmonary tuberculosis were rare" without more proof or a more reasonable explanation than we were able to gather from the literature at our disposal. Why the eye should possess this peculiar immunity in the presence of a definite pulmonary tuberculosis, in which the patient was toxic, emaciated and expectorating millions of tubercle bacilli, we could not answer, nor could we reconcile it to the diagnosis frequently made in the absence of these symptoms in a robust and apparently healthy person having an indefinite eye lesion but disclosing a positive tuberculin reaction.

It appeared to us that, if a lesion of the eye was due to the tubercle bacillus or its toxins, it should be seen in persons suffering from active tuberculosis, just as we would expect a syphilitic optic neuritis or iritis in one having syphilis or a gonorrheal conjunctivitis in one having a gonorrheal infection. We surely would not be justified in expecting such conditions to exist in persons who had not been so infected.

In view of these discrepancies we felt that if a routine examination of the eye in a large series of proved cases of tuberculosis was made, we would probably find relatively as many such lesions as are found in other general diseases producing pathologic changes in the eye. With this idea in mind, a complete survey of the institution was begun in the hope that definite information would result from such an attempt. At least, we should be able either to confirm or to refute current opinion or disclose some information that might be of value to the subject.

The Municipal Tuberculosis Sanitarium offered this opportunity. This institution is unique in that it is the largest sanatorium in the world and gives highly specialized care to its patients through its staff of resident physicians and an attending staff consisting of specialists in every division. The 1,200 patients in residence are selected from more than 51,000 patients which the organization controls through a series of adequately staffed dispensaries throughout the city.

The patients were plentiful, and the history records complete and detailed; both the resident and the attending staff cooperated in every way possible. The following factors were considered in every case submitted in this survey: age, sex, occupation, race, tuberculous diagnosis, pathologic type, duration of disease, toxicity, roentgenograms, temperature, sputum, Wassermann reaction, complement fixation for tuberculosis, and complications. The ocular survey consisted of a determination of tension (by finger palpation) and of relative vision; examination of the eyelids, extrinsic muscles, conjunctiva, cornea, anterior chamber and iris; tests of the reaction to light and in accommodation; examination of the lens, vitreous, nerve head, vessels, retina and macula, and a consideration of the ocular symptoms. The external examination was made and recorded; then the iris was dilated with homatropine and

the fundus examined in minute detail. When the patient would not submit to atropine dilation, observations of the fundus were not included in this part of the survey.

There were many difficulties to overcome in a survey of this size and character; many of the patients were bedridden, and examination had to be made in the recumbent position. Most of them had to be examined in their wards or rooms; therefore it was impossible to record vision on a mathematical basis, and we had to accept the patient's statement as to visual acuity. The electrical ophthalmoscope was used throughout, except when a reexamination had to be made; thus in some cases we probably overlooked very fine floaters in the vitreous, which must account for the small number so recorded. Tension was by finger palpation; here too we may have missed some slight changes, but we can definitely state that not one frank case of glaucoma was seen. Each fundus was examined in minute detail by one of us; when any deviation was noted, the patient was reexamined by both of us. Moderate or mild arteriosclerosis, as evidenced by knuckling, by the appearance of the blood vessel and by colloidal spots (drusen), was not considered of sufficient import to this survey to be recorded. Those disclosing more marked pathologic changes were later grouped, and reexamined by both of us with a regulation Morton ophthalmoscope; the indirect method was used only when indicated. The cases of interest were described in minute detail (presented in the accompanying case reports), and in a number of them fundus photography was attempted with more or less success.

In addition we have recorded the conditions noted in the external eye and the general physical and laboratory observations in 105 so-called contact cases. By a contact case we mean a child that has been exposed to active tuberculosis in some member of his or her family. There are some 11,000 such children under the supervision of the Municipal Tuberculosis Sanitarium in the various schools of Chicago at this time.

Many interesting data have been accumulated as the result of this survey, although of no import to this report, which is limited to the presence of ophthalmic tuberculosis in the tuberculous subject.

The ophthalmic department of the sanatorium is probably in no way different from that of a general hospital in the type and number of eye cases referred. The symptoms most commonly complained of are those of muscular asthenopia, that is, smarting and burning sensation of the eyes. These symptoms are referable to the general asthenia, exposure to bright light, fresh air and excessive use of the eyes. The patients are confined to bed and read a great deal under unfavorable conditions, so that small refractive errors that under ordinary conditions would produce no symptoms seem to give much annoyance.

Table 1 discloses a total of 1,178 patients examined in this survey, of whom 1,073 had proved tuberculosis, and 105 were so-called contact cases, the latter consisting almost entirely of children. In the 1,073 patients, the examination of 159 was limited to the external parts, that is, what could be seen with a condensing lens and loupe; the remaining 914 received in addition a complete examination of the fundus after the pupils were dilated with homatropine.

TABLE 1.—*Summary of Examinations*

Tuberculous cases in which only external examination was made	159
Tuberculous cases in which external and fundus examination was made	914
Total number of cases of proved tuberculosis in which examination was made	1,073
Contact cases (not proved tuberculosis) in which only external examination was made	105
Total number in this survey	1,178

TABLE 2.—*External Observations of the Eye* *

Orbital abscess†	—bilateral		1
Enucleated			1
Eyelids	Ptosis	1	
	Ectropion	1	
	Xanthelasma	1	
	Pterygium	1	
			4
Eye muscles	Convergent strabismus	9	
	Divergent strabismus	3	
			12
Nystagmus	—ophthalmic		3
Cornea	Interstitial keratitis	1	
	Opacities of cornea of all types	21	
	Phlyctenular keratitis	2	
			24
Iris	Tremulous	3	
	Iritis	7	
	Coloboma	1	
	Persistent pupillary membrane	2	
			13
Lens	—aphakia		3
Total			61

* Blepharitis, chalazia, hordeolum and such minor conditions were not considered.

† Bilateral proptosis in an old man suffering intense pain and in the last stages of tuberculosis.

Table 2 discloses the external observations in 1,073 cases of tuberculosis. The diagnosis is based on the clinical symptoms, roentgen examination, tests of the sputum and complement fixation reactions for both syphilis and tuberculosis.

The most interesting condition disclosed in table 2 is that of involvement of the uveal tract, which we consider of sufficient import to describe in minute detail in a special table and in individual case reports.

Uveal tuberculosis has been a controversial subject for many years. The evidence disclosed in this survey is significant, if not remarkable. In 1,073 examinations of patients with proved tuberculosis, only 13 were found showing any involvement of the iris. In these 13 cases there were

3 of tremulous iris, the result of removal of the lens or lenses (aphakia); one was a case of congenital coloboma; two were cases of persistent pupillary membrane as manifested in hairline threads on the anterior surface of the iris, readily seen after dilation of the pupil, and the remaining seven were cases of iritis, to be considered in detail.

CASES OF IRITIS

CASE 1.—L. M., a man, aged 24, divorced, an assistant undertaker, had had two acute attacks of redness, soreness and blurred vision. On examination the right eye appeared normal; in the left eye there was some evidence of gray exudate on the posterior surface of the cornea at 6 o'clock; the iris was inflamed and discolored. The diagnosis was acute iritis. Tension to palpation was slightly greater in the left eye than in the right. The laboratory diagnosis was minimal tuberculosis. The last report on the sputum was negative. The roentgenogram was typical of well advanced tuberculosis. The Wassermann reaction was 4+; the Kahn reaction 4 +. The condition appeared to us distinctly syphilitic, as was borne out by the laboratory observations. The patient was placed on atropine locally and antisyphilitic treatment. His recovery was rapid and uneventful There was no evidence of tubercles in the iris. The final diagnosis was acute iritis, most likely of syphilitic origin.

CASE 2.—G. P., a man, aged 36, married, a truck driver, had vision in the right eye of 20/25; in the left eye, 20/100. Old tags of previous iritis were present in both eyes. A diagnosis of moderately advanced tuberculosis had been made. The last report on the sputum was negative. A roentgenogram did not show any frank evidence of tuberculosis. The first Wassermann reaction was negative; the second test was positive. The etiology of the iritis was exceedingly doubtful.

CASE 3.—O. G., a Negress, aged 32, married, a housewife, had had sore eyes at about 10 years of age. The general health at that time was good. The right eye showed marked diffuse brown pigment on the anterior capsule of the lens. With a loupe these were seen as individual brown pigment spots. No synechiae were present. The left eye showed brownish pigment on the anterior capsule in the region of the pupillary margin. There were no synechiae. The pupils dilated perfectly. There was no evidence of nodules or of connective tissue formations on the anterior surface of the iris. The condition appeared to us more like a syphilitic than a tuberculous iritis. A diagnosis of far advanced tuberculosis had been made. There was an elevation of temperature. A roentgenogram showed well advanced tuberculosis, and the last report on the sputum was positive. A complement fixation test was negative. The Wassermann reaction was negative. The etiology was doubtful.

SECONDARY IRITIS

CASE 4.—P. D., a man, aged 50, single, a waiter, showed a large opacity on the cornea of the right eye at 7 o'clock. There was evidence of old iritis and the lens was opaque. Tension was normal. There was a slight pupillary response to light, but no light perception or projection. The patient stated that he had received an injury to the right eye in early childhood. The left eye showed several diffuse central opacities of the cornea. Vision was 15/200, slightly improved with glasses. The pupil dilated well with atropine and showed no synechiae or evidence of previous iritis. The fundus was seen through a heavy

fog, but no marked pathologic condition was detected. A diagnosis of minimal tuberculosis had been made. The last report on the sputum was negative. The Wassermann reaction and complement fixation tests likewise were negative. A roentgenogram did not give any evidence of tuberculosis. The condition was considered traumatic iridocyclitis.

CASE 5.—M. H., a woman, aged 21, single, a maid, showed good pupillary reflexes in the right eye and a normal fundus. The pupillary reflexes in the left eye were good except at 5 o'clock, where the iris was adherent to the scar of the cornea. The remains of an opaque lens capsule and lenticular matter were seen in the pupillary area. This was secondary to a traumatic cataract, the result of a penetrating wound. The eye deviated upward and out. A diagnosis of moderately advanced tuberculosis had been made. The last report on the sputum was negative and the Wassermann reaction was negative. A roentgenogram showed no evidence of tuberculosis. The ocular condition was complicated by hyperthyroidism. The ophthalmic dignosis was traumatic iridocyclitis.

CASE 6.—A. H., a saleswoman, aged 37, single, showed maculae of both corneas. In the left eye, leukoma adherens was present, the result of perforation of the cornea (possibly due to previous ulcers of the cornea). A diagnosis of minimally advanced tuberculosis had been made. The last report on the sputum was negative. A roentgenogram showed no evidence of pulmonary tuberculosis. The possibility of a cardiac condition was considered. The Wassermann reaction was negative. Complement fixation tests were negative. The final diagnosis was leukoma adherens.

CASE 7.—T. O'D., a man, aged 47, single, a laborer, had vision in the right eye of 20/13, and with the left eye he was able to see fingers at a distance of 1 foot (0.3 meter), when looking temporalward. A cataract operation had been performed on the left eye; some lenticular matter and capsule remained. Anterior synechiae were seen at 9 o'clock. A diagnosis of moderately advanced tuberculosis had been made. A roentgenogram showed far advanced tuberculosis with cavitation. The last report on the sputum was negative. The Wassermann reaction was negative. Anterior synechiae were present as a result of the cataract operation.

Of the seven patients it would appear to us that patient 1, although tuberculous, had clinically a syphilitic iritis, since he gave frank positive serologic tests and responded rapidly to antisyphilitic treatment; that is, he responded much more rapidly than would have been expected had the condition been a pure tuberculous iritis. It must also be remembered that the treatment for tuberculosis in the sanatorium is primarily the usual therapeutic regimen of rest, diet, sunlight and fresh air.

Patients 2 and 3, in whom there was found evidence of an old iritis involving both eyes, showed no evidence of a healed tubercle. There were three cases that would appear to disclose synechiae as the result of trauma—two by direct violence and one following cataract extraction. One case of leukoma adherens was seen, the result of a perforated corneal ulcer with prolapse of the iris.

A summary of these seven cases would appear to indicate that at the most we can consider only three cases as of possible tuberculous origin. One (case 1) of these in our opinion was a frank case of syphilis; in

TABLE 3.—*Clinical and Laboratory Observations in Seven Cases of Iritis*

Diagnosis	Age	Race	Sex*	Eye	Wassermann Reaction	Kahn Reaction	Tuberculosis	Sputum	Roentgenogram	Appearance of Iris
Acute iritis	24	Colored	♂	Left	4+	4+	Minimal	—	Well advanced tuberculosis	Typical acute case
Old iritis	36	White	♂	Both	—1st +2d	Not made	Moderately advanced	—	No frank— evidence	Old tags of previous iritis
Old iritis	32	Colored	♀	Both	—	Not made	Far advanced	+	Well advanced tuberculosis	Iris pigment on anterior capsule
Traumatic iritis (old)	50	White	♂	Right	—	Not made	Minimal	—	Nontuberculous	Posterior synechiae
Traumatic iritis	21	White	♀	Left	—	Not made	Moderately advanced	—	No evidence of tuberculosis	Anterior synechiae at 5 o'clock
Following cataract operation	47	White	♂	Left	—	Not made	Moderately advanced	—	Far advanced with cavitation	Following cataract operation
Perforating ulcer; anterior synechia	37	White	♀	Left	—	Not made	Minimal	—	No evidence of tuberculosis	Leukoma adherens

* In this column ♂ indicates male; ♀, female.

one there was a negative Wassermann reaction at first and later a positive reaction, and the other is of doubtful origin.

If we consider the three cases as tuberculous, the proportion is 0.27 + per cent. If we consider all seven cases as tuberculous, the proportion is 0.65 + per cent.

It is not unusual to find tuberculosis and syphilis existing together. Five per cent of all patients admitted to the sanatorium in the past year gave positive serologic reactions for syphilis.

In table 4 we have endeavored to classify the observations on the fundus in 914 cases of proved tuberculosis as we saw them and as we think they may safely be classed. We have disregarded the state of the blood vessels except when other pathologic changes were found; colloidal spots, or drusen, were likewise ignored. Of these 914 cases, 104 showed deviations from the normal, as follows: incipient cataract (dis-

TABLE 4.—*Conditions Observed in Fundus*

Lens	Incipient cataract		6*
Vitreous	Floating opacities		8†
Optic nerve	Slight pallor of disk	9	
	Postneuritic atrophy	2	
	Peripapillary atrophy	1	
			12
Choroid and retina	Various types (see table 5)		78
Total			104

* Where vision was disturbed.

† Vitreous opacities not easily detected with electrical opthalmoscope, and conditions under which examinations were conducted.

turbing vision), 6 cases; vitreous opacities, 8 cases (this figure, we are sure, is too low, but it is due to the conditions under which examination was made); nerve head, 9 cases showing slight pallor due to anemia; postneuritic atrophy, 2 cases; peripapillary atrophy, 1 case; retinal and choroidal changes, 78 cases. The classification of the last named group has been made according to the type of spot and the character of the pigment; when the pathologic involvement was more extensive than a minute spot, it has been included in the case reports.

Of the 914 cases of proved tuberculosis in which a complete examination of the fundus was made, table 5 summarized 78 showing deviations in the choroid and retina after the pupils were dilated with homatropine. Of these, only 3 cases disclosed fresh hemorrhages: One was a case of nephritis and another a case of diabetes with nephritis; in the third case, a small flame-shaped hemorrhage of unknown origin was found. Forty-four cases in which the abnormalities were limited to 1 or 2 small coal black pigment spots (pigment epithelium) of from 1 to 2 mm. in diameter were noted; this could probably be found in a like number of so-called normal persons in a survey of a like number of cases. There

were 7 cases in which the only pathologic condition found was limited to 1 or 2 small yellowish or grayish spots, without evidence of pigment. These are not the so-called drusen or colloid spots, but changes which one sees occasionally in the retina which would in no way impress the observer as being tuberculous. In the division referred to as miscellaneous cases, which we likewise were willing to exclude as of possible tuberculous origin, a boy, aged 10, presented a salt and pepper fundus; another had a unilateral postneuritic atrophy, with a pseudoretinitis pigmentosa, and 3 patients showed slight macular changes without marked disturbance of vision. This leaves only 19 cases to be considered from a tuberculous standpoint. The positive diagnosis of these cases we are unwilling to assume; we are inclined to think that they should be given serious consideration.

TABLE 5.—*Deviations of the Choroid and Retina Observed in Seventy-Eight Cases*

Fresh hemorrhage	Nephritic	1	
	Nephritic and diabetic	1	
	1 small hemorrhage	1	
			3
Minute coal black pigment spots (pigment epithelium)	1 or 2 in each case of 2 mm. or less in diameter; the majority had only one spot of about 1 mm.		44
Minute yellow or gray spots without pigment	Limited to 1 or 2 spots, but not colloidal or drusen		7
Miscellaneous	Salt and pepper fundus (boy of 10)	1	
	Pseudoretinitis pigmentosa with postneuritic atrophy	1	
	Slight macular change	3	
			5
Possibly tuberculous	(See individual case reports)		19
Total			78

In this survey we did not come in contact with a single active tubercle of the eye, a condition that is usually associated with a miliary or embolic tuberculosis. On the basis of which changes or factors a diagnosis of tuberculosis of the choroid or retina in the healed state is justified, we are not sure. We therefore submit these nineteen cases, which in our opinion seem to deviate from the normal sufficiently and uniformly enough to warrant study.

The pathologic changes with which we were impressed were as follows: (*a*) The comparatively normal blood vessels in the presence of marked choroidoretinal changes. (*b*) The white, yellowish or grayish spots surrounded by a fringe of pigment epithelium, which appeared as if it were being slowly bleached out (like a black pen and ink sketch that had been partially exposed to sunlight for a long time). The inner circumference of these spots was frequently well defined, and if they were large, pigment of various types and size was present in the center; if the pigment was of the choroidal type (chromatophores), it did not seem to show evidence of fading to the same extent as was seen in the

pigment epithelium type. (*c*) The large diffuse areas of a light yellowish-pink or light gray in which the pigment was irregularly distributed and in which the pigment epithelium showed various stages of bleaching, whereas the chromatophores were not so changed. In this type we found in some cases, in addition, several small well defined pigment spots of the faded type, slightly distant from the larger diffuse areas.

These changes, we are inclined to think, were of tuberculous origin, probably brought about at some previous time by a tubercle that was now healed; the picture was that of the resultant tissue reaction to the infection.

REPORT OF CASES

CASE 8.—W. Z., a man, aged 47, single, Polish, a chef, on external examination showed a normal cornea, iris and anterior chamber. The disk, vessels and macula of the right eye were normal. Many round pigment spots occupied the lower field. The smaller spots were near the disk and became progressively larger

Figure 1

Figure 2

Fig. 1.—Evidence of spots is seen in the lower part of the left side of the picture. The pathologic changes are not well shown. Note the absence of vascular changes.

Fig. 2.—The more typical spot is not shown. The picture would indicate blurred disk margins, which is not true. This and other high lights are common in the fundus of a Negro.

toward the periphery (fig. 1). These pigment spots were grouped in a wedge-shaped arrangement, the apex of the wedge toward the disk. The disk, vessels, retina and macula of the left eye were normal. Temporal traction conus was present. A diagnosis of far advanced tuberculosis had been made. There was an elevation in temperature and a roentgenogram showed well advanced tuberculosis. The last report on the sputum was positive. The Wassermann reaction was positive. Tuberculous enteritis was present.

CASE 9.—W. D., a Negro, aged 39, single, an automobile mechanic, on external examination showed a normal cornea, iris and anterior chamber. In the right fundus the disk, vessels, retina and macula were normal. In the left fundus the disk, macula and vessels were likewise normal. One large grayish-black pigment spot was present, slightly larger than the disk and about 2 disk diameters below it. Another dark gray spot was present with a lighter area in the center, not as large as, and inferior to, the first (fig. 2). A diagnosis of minimal tuberculosis

had been made. The temperature was not elevated. A roentgenogram showed old hilus tuberculosis without parenchymatous involvement. The last report on the sputum was negative. The Wassermann reaction was negative, as were also complement fixation tests.

CASE 10.—A. B., aged 19, single, German, a home girl, on external examination showed a normal cornea, iris and anterior chamber. The disk vessels, retina and macula of the right eye were normal. In the left eye the disk and vessels were normal. There was a large irregular area of coal black pigmentation in the macular region. Several smaller black spots were seen toward the temple. The pigment was faded, and each one was surrounded by a yellowish-pink area (fig. 3). Several similar spots were also seen inferior to the macula. A diagnosis of moderately advanced tuberculosis had been made. The temperature was elevated. A roentgenogram showed active tuberculosis. The last report on the sputum was positive. The Wassermann reaction was negative. Complement fixation tests were positive.

CASE 11.—L. de L., a woman, aged 27, married, an American housewife, on external examination of the right cornea showed fine superficial vascularization

Figure 3

Figure 4

Fig. 3.—Color shading cannot be shown. This is a fairly good picture of the irregular diffuse type.

Fig. 4.—The pigment is of the heavier type. Note the absence of vascular changes.

throughout the entire circumference, with a diffuse opacity just below the center. In the left cornea there was arborization of the superficial vessels, extending about 2 mm. into the cornea beyond the limbus. In the right fundus was one choroidal pigment area about the size of the disk and about 2 disk diameters nasalward from the disk. Through this area there was some lighter detail of intact choroid (fig. 4). The pigment did not possess the washed-out appearance shown in other cases. One small spot, about one-fourth disk diameter, slightly nasalward from the preceding spot, was of the faded type. In the left fundus the disk, vessels, retina and macula were normal. A diagnosis of minimal tuberculosis had been made. A roentgenogram showed fairly well advanced tuberculosis. The temperature was elevated. The last report on the sputum was positive. The Wassermann reaction was negative. The patient had had a phrenic nerve operation.

CASE 12.—N. H., a woman, aged 54, married, an American housewife, on external examination showed a normal cornea, iris and anterior chamber. In the right eye the nerve head, retina, vessels and macula were normal except for one colloid spot above the macula. In the left eye the disk and vessels were normal;

there were a temporal choroidal ring and a number of large irregular areas of pigment surrounded by a diffuse area of gray. The pigment appeared faded. There was one large pigment spot of the same type in the temporal region below the macula. A diagnosis of glaucoma had been made seven years before. We could not see any evidence of it. The examination indicated far advanced tuberculosis of the fibroid type. The temperature was elevated. A roentgenogram showed fairly well advanced tuberculosis. The last report on the sputum was positive. The Wassermann reaction was positive. Complement-fixation tests for tuberculosis were positive. Other complications present were myocarditis and a diseased gallbladder; the patient was bedridden.

CASE 13.—G. W., a woman, aged 22, single, American, a stenographer, on external examination presented a normal cornea, iris and anterior chamber. In the right eye the disk, retina and macula were normal. There was some knuckling of the vessels. In the left eye the disk was normal; one round pigment spot was seen, one-half the size of the disk, 3 disk diameters to the temporal side of disk and upward from the macula, with a lighter aura around the pigment. The pigment was of a faded slate color. Fine vessels coursed over this spot. A diagnosis of moderately advanced tuberculosis had been made. The temperature was elevated. A roentgenogram showed well advanced tuberculosis. The last report on the sputum was positive. The Wassermann reaction was negative.

CASE 14.—A. T., a saleswoman, aged 39, divorced, American, on external examination showed a normal cornea, iris and anterior chamber. In the right fundus the disk, vessels, retina and macula were normal. In the left, the disk was normal, with a small bluish-gray spot on the temporal edge at 9 o'clock. A large bluish-white area of 3 disk diameters was present in the nasal field, surrounded by faded pigment; two small spots of grayish-yellow, without pigmentation, were seen peripheral to the pigment. A diagnosis of moderately advanced tuberculosis had been made. The temperature was elevated, and the last report on the sputum was positive. The Wassermann reaction was positive. A roentgenogram showed advanced tuberculosis. Hypertension was present as a complication.

CASE 15.—F. S., a man, aged 26, married, German, a clerk, on external examination showed a normal cornea, iris and anterior chamber. In the right fundus there was glial tissue on the vessels on the disk, and slightly beyond. From about 12 to 2 o'clock there were diffuse yellowish-pink elongated areas in the nasal and upper nasal fields, following the course of the vessels with fine pepper-like pigment spots in these areas. The left disk, vessels, retina and macula were normal. A diagnosis of far advanced tuberculosis had been made. The temperature was elevated, and a roentgenogram showed the disease far advanced with cavities. The last report on the sputum was positive. The Wassermann reaction was negative.

CASE 16.—O. I., a man, aged 23, a machinist's helper, Norwegian, on external examination presented a normal cornea, iris and anterior chamber. In the right fundus the disk and vessels were normal; there was one elliptic yellowish-white area, about ½ to ⅔ disk diameters, lying above the macula, with the inner borders well defined and surrounded by a delicate fringe of faded pigment. In the left eye the disk, vessels, retina and macula were normal. A diagnosis of far advanced tuberculosis had been made. The last report on the sputum was positive. The Wassermann reaction was negative. A complement fixation test was negative. Marked dilatation of the sigmoid was present, and tuberculosis of

the lower bowel was suspected. This patient could not be reexamined because he was removed to the Psychopathic Hospital.

CASE 17.—R. N., a woman, aged 44, married, a Swedish housewife, on external examination showed a large central opacity of the left cornea. The iris and anterior chamber were normal. In the right fundus there was some pallor of the disk. Two black pigment spots were on the disk at 9 o'clock. A large diffuse yellowish-gray area extended from the disk downward and nasalward, with scattered washed-out pigment throughout the area. The macula was normal. In the left eye, because of diffuse opacity of the lower part of the cornea and a small linear opacity above this, the details of the fundus could not be seen. A diagnosis of far advanced tuberculosis had been made. There was an elevation in temperature. A roentgenogram showed far advanced tuberculosis. The last report on the sputum was positive. The Wassermann reaction was negative.

CASE 18.—B. M., a man, aged 49, Irish-American, an electrician, on external examination presented a normal cornea, iris and anterior chamber. The right fundus showed a normal disk and vessels. Diffuse grayish-pink areas with small faded black pigment spots were present throughout the macular region. In the left eye the disk, vessels, retina and macula were normal. A diagnosis of advanced tuberculosis had been made. The temperature was not elevated. The last report on the sputum was negative. The Wassermann reaction was negative. Scoliosis was present as a complication.

CASE 19.—J. R., a man, aged 47, single, Irish, a chemist, was found on external examination to have a normal cornea, iris and anterior chamber. The disk and vessels of the right fundus were normal. An ill defined elliptic area was present in the macula about one-fourth the size of the disk and grayish-pink, with slight pigmentation. The disk, vessels, retina and macula of the left eye were normal. A diagnosis of far advanced tuberculosis had been made. The temperature was elevated. The last report on the sputum was negative. The Wassermann reaction was negative. A roentgenogram revealed nonactive tuberculosis.

CASE 20.—A. P., a woman, aged 42, single, Croatian, a cook, on external examination showed a normal cornea, iris and anterior chamber. In the right fundus was a greenish-black spot about one-half disk diameter between the disk and the macula; there was a diffuse yellowish-gray area to the temporal side of the macula, interspersed with pigment, some of which was of the faded type. Vision was good. The disk, retina and macula of the left eye were normal. The tuberculous diagnosis was well advanced tuberculosis with a large cavity. A roentgenogram showed active tuberculosis. The last report on the sputum was positive and a complement fixation test was positive. The Wassermann reaction was positive.

CASE 21.—E. M., a woman, aged 41, married, American, a housewife, on external examination showed a normal cornea, iris and anterior chamber. The disk, retina, vessels and macula of the right fundus were normal. In the left eye a large grayish spot of crescent shape was below the disk, with one black pigment spot in the center of the crescent. A diagnosis of minimal tuberculosis had been made. A roentgenogram revealed that the disease was far advanced. The last report on the sputum was positive, as was also a complement fixation test. The Wassermann reaction was negative.

CASE 22.—M. M., a home girl, aged 19, single, Italian, on external examination showed a normal cornea, iris and anterior chamber. In the right fundus there was one brownish-black pigment spot of about one-third disk diameter, inferior to the disk. The left fundus was normal. A diagnosis of minimal tuberculosis

had been made. A roentgenogram showed well advanced tuberculosis. The last report on the sputum was positive and the temperature was elevated. The Wassermann reaction was negative.

CASE 23.—A. A., a factory girl, aged 21, single, a Lithuanian, on external examination showed a normal cornea, iris and anterior chamber. In the extreme periphery of the left fundus on the nasal side were several small, round pigment spots about 2 to 3 mm. in diameter, and one anterior to the vessel, with pigment of the faded type. The right fundus was normal. The diagnosis was negative for tuberculosis. A roentgenogram showed the disease well advanced. The last report on the sputum was positive. The temperature was elevated. The Wassermann reaction was negative.

CASE 24.—P. L., a man, aged 60, married, German, a clerk, on external examination showed a normal cornea, iris and anterior chamber. Vision was good in the right eye and fair in the left. The fundus of both eyes showed diffuse pigment spots on the nasal side of the disks. The patient stated that this resulted from an electric flash many years ago. These spots were not characteristic of any particular type. A diagnosis of fairly well advanced tuberculosis had been made. The last report on the sputum was negative, and the Wassermann reaction was negative.

CASE 25.—H. B., a woman, aged 26, Swedish, single, doing housework, showed greenish-black spots between the disk and the macula in the fundus of the right eye, with a faded black diffuse area throughout the temporal area beyond the macula. The left eye was normal. A diagnosis of far advanced tuberculosis had been made. A roentgenogram showed the disease well advanced, with evidence of cavitation. The temperature was elevated. The last report on the sputum was positive. The Wassermann reaction was negative. A complement-fixation test was positive.

CASE 26.—G. W., a woman, aged 22, single, American, a stenographer, on external examination showed a normal cornea, iris and anterior chamber. In the right fundus the disk, retina and macula were normal. In the left, a greenish-black spot of 1 disk diameter was seen above the macula. A diagnosis of minimal tuberculosis had been made. A roentgenogram showed the disease well advanced. The temperature was elevated. The last report on the sputum was positive. The Wassermann reaction was negative.

COMMENT

Table 6 summarizes these nineteen cases, giving the case number, age, sex, eye involved and the part of the fundus showing pathologic change. It is interesting to note that in eighteen the involvement was unilateral, and that the one bilateral case was different from the others, the history indicating that the changes were the result of an electric flash. It is also interesting to note that only one area of the field is involved in a given case; that is, in no case do both the nasal and the temporal fields, or the upper and the lower fields, show pathologic changes. A definite field may overlap an adjoining field, but never a field opposite to the other side of the disk.

In table 7 are recorded the observations in 105 contact cases in children who, with the exception of 3, were between the ages of 7 and 14.

These children were in contact with active open pulmonary tuberculosis and showed evidence of tuberculous infection but not of active tuberculous disease. The evidence of tuberculous infection in this group was demonstrated by a positive Mantoux test and a dermatubin reaction in 81 per cent. All other pertinent laboratory evidence was negative.

DIAGNOSIS OF TUBERCULOSIS OF THE EYE.

On the basis of what factors, clinical or otherwise, may one make a definite diagnosis? Given a case of a definite tubercle, whether in the iris

TABLE 6.—*Summary of Cases of Ocular Tuberculosis*

Case	Age	Sex	Eye	Area Involved
12	54	♀	Left	Temporal
8	47	♂	Right	Below
13	22	♀	Left	Temporal
14	39	♀	Left	Temporal
15	26	♂	Right	Nasal and upper
16	23	♂	Right	Temporal
17	44	♀	Right	Below and nasal
18	58	♂	Right	Temporal
9	39	♂	Left	Below
10	19	♀	Left	Temporal
19	47	♂	Right	Temporal
11	27	♀	Right	Nasal
20	42	♀	Right	Temporal
21	42	♀	Left	Below
22	19	♀	Right	Below
23	21	♀	Left	Nasal
24*	60	♂	Both	Diffuse pigment spots on nasal side of each
25	28	♀	Right	Temporal
26	22	♀	Left	Temporal

* Both nasal fields were involved in this case as the result of an electric flash many years ago.

TABLE 7.—*Ocular Conditions Noted in Contact Cases in Children*

Recurrent styes	1
Opacities of cornea	3
Phlyctenulosis (one doubtful)	2
Convergent strabismus	3
No abnormalities	96
Total	105

or in the fundus, the diagnosis is probably not difficult and yet not as easy as many believe. A single tubercle of the iris may be large, and is often difficult to differentiate from a gumma or a small neoplasm. If it is associated with an acute miliary tuberculosis, the diagnosis may more readily be made; if not, the other diseases will have to be excluded by laboratory or therapeutic methods.

If the tubercles are many, they are then usually very small. In the presence of an acute miliary or embolic tuberculosis, the diagnosis again should not be difficult. In the absence of a miliary tuberculosis, the diagnosis becomes difficult, and differentiation must be made from other diseases.

The so-called lardaceous spots or exudates on the posterior surface of the cornea are not pathognomonic; they merely indicate the intensity of the tissue reaction to an irritant which may or may not be of a tuberculous origin.

In the many forms of iritis or iridocyclitis in which the etiology cannot be ascertained by any of the methods at our disposal, a diagnosis of tuberculosis based on the reaction resulting from the use of tuberculin is not, in our opinion, justified.

In the fundus the same problem is encountered; here, again, the presence of solitary or multiple tubercles must be differentiated from the many pathologic states that can produce a similar picture of one or many, small or large, exudates which show elevation and evidence of active inflammation. When associated with a miliary tuberculosis, such a diagnosis may be justified. In the absence of definitely proved tuberculosis, by which we mean recognized clinical or laboratory evidence, such a diagnosis is not justified. The use of tuberculin as a diagnostic means will be discussed later.

We are inclined to think that the lesion of the healed or quiescent fundus that we have found and cited in this survey is of tuberculous origin. The changes that we have noted most frequently seem to us of such uniform character as to justify serious consideration. The blood vessels do not show that evidence of sclerosis which is usually seen when a marked pathologic condition of the fundus exists.

White, gray and yellowish spots seen in the healed state show no elevation, but if they are of about 3 mm. or more in diameter they disclose a fringe of pigment which may completely encircle the spot or may be limited to one side. If the spot is large it may be round or elliptic, punched out or with irregular edges, and frequently there is some pigment in the center.

The type and characteristics of this pigmentation we are inclined to think are of importance to the diagnosis. The pigment surrounding these spots is usually of the pigment epithelial type, scanty and in various stages of discoloration; that is, it appears to be fading. In the larger spots, where pigment is also present in the center, it is more frequently of the choroidal type and does not appear to show this faded phenomenon to the same extent, if at all.

In those cases showing large diffuse irregular areas, the coloring is not always uniform. One may see in such a picture all that is described in the isolated spots, but as if they were adjoining each other and often overlapping one another; the pigment likewise is irregular, and of various types and stages of fading, but always scanty. Most of these cases disclose several small cleancut isolated spots nearby, with apparently normal retina and choroid intervening. The blood vessels, how-

ever, do not show the evidence of arteriosclerosis that one would expect where such extensive destruction had taken place. We have photographed a few of these fundi with some success, but the color shading is difficult if not impossible to bring out in a black and white picture.

The interesting phenomenon associated with most of these cases is the fact that they are unilateral, a condition which it would appear to us could take place only in the presence of an embolus.

THE FOCAL REACTION TO TUBERCULIN

The use of the tuberculin reaction for the purpose of diagnosis has been resorted to to such an extent that it is almost accepted as definite and indisputable. This is probably due to the fact that tuberculosis of the eye is much less frequently encountered than we are led to believe, whereas there still remain many ocular disorders that we have been unable to classify, which frequently give a positive tuberculin reaction on the basis of which a diagnosis is accordingly made. Treatment is instituted along these lines, particularly the use of tuberculin, and, as may be expected, a tuberculous process responds slowly to any treatment; therefore many of these patients get well eventually. It is more than likely that, over the same period, such cases would have responded just as well had tuberculin not been used.

These statements may appear to some as a radical departure from tradition, but evidence is accumulating rapidly that must change the point of view in diagnosis and therapy.

In 1917 and 1918 one of us (M. G.[1]), reporting on phlyctenulosis, maintained that this disease was not due to the tubercle bacillus or its toxins, and that the only factor on which such a diagnosis could be based was the positive Pirquet reaction, which in his opinion was of doubtful value. Since then the literature, which is now extensive, discloses that such reactions can be brought about by other substances; furthermore that a similar reaction can be precipitated around or in a nontuberculous inflammatory focus by the use of tuberculin.

William F. Petersen,[2] of the department of pathology of the University of Illinois, said:

> Let us examine the so-called focal reaction which plays so large a rôle in our therapy, ordinarily considered a purely specific phenomenon. We inject a moderate size dose of tuberculin into a tuberculous individual and we promptly find signs of activation at the focus, increased vascularization, increased produc-

1. Goldenburg, Michael: The Pathogenesis of Ophthalmia Eczematosa, J. A. M. A. **69**:104 (July 14) 1917; The Pathogenesis of Ophthalmia Eczematosa, Illinois M. J. **34**:272 (Nov.) 1918.

2. Petersen, W. F., in a paper read before a joint meeting of the Chicago Tuberculosis Society and the Chicago Medical Society, Jan. 29, 1930.

tivity, etc., and we conclude that this reaction must be purely specific, a fallacy so thoroughly impressed on the medical mind that it is impossible to eradicate it. Practically every extract of the glycerinated bouillon in which tubercle bacilli have never been grown will produce a tuberculin reaction. Many substances produce a tuberculin reaction about a tubercle, and, conversely, tuberculin produces a tuberculin reaction about many chronic inflammatory foci that are not of tuberculous origin. The reaction about a tubercle that we call the focal reaction is one that involves stimulation, capillary dilatation, usually with a reversal to impermeability following in its wake. When we overstimulate, this reversal does not recur—the increase in permeability continues too long and injury takes place. This reaction is almost identical, whether we use tuberculin or a gold salt or any of the immune tuberculosis serums, or sunlight, or whether it is due to a menstrual cycle.

Dr. Benjamin Goldberg,[3] medical director of the Municipal Tuberculosis Sanitarium of Chicago, said:

Concerning the value of tuberculin as a diagnostic aid in eye conditions, we must first insist that our present knowledge dictates that this substance is not specific as to tuberculosis. When there is a reaction resulting from the use of tuberculin in diagnostic doses, the focal reaction is evidenced by an increase in the exudate rather than absorption of the exudate, and the rise in temperature is indicative of this new exudate and toxin absorption from such processes. Personally, after a number of years of experience in the use of tuberculin diagnostically, I have entirely dispensed with its use. The danger of increased exudation in the eye should be no less than the danger in the lung. Concerning the use of tuberculin in the treatment of tuberculosis, I have observed no benefit derived from such use and have finally decided that its only possible indication is in the localized, limited, quiescent tuberculous process, and in this condition, the tuberculosis being walled off, requires no special tuberculin irritation.

Dölter[4] obtained a positive tuberculin reaction in children by the intracutaneous injection of glycerinated bouillon (Höchst).

Kreibich[5] succeeded in sensitizing adults to tuberculin by intracutaneous injections of water.

De Potter[6] injected tuberculin and various nonspecific substances into tuberculous patients and concluded that the reactions were similar.

Bardswell,[7] in a lengthy discussion, stated that "it is in the cases in which assistance is most needed that the tuberculin test is least likely to give any indications." In his opinion, the test is not a means whereby the existence or absence of tuberculous disease can be determined.

In view of this accumulated information and much more that cannot be quoted, it would appear that authorities on tuberculosis are agreed

3. Goldberg, Benjamin, in a discussion of tuberculosis of the eye before the Chicago Ophthalmological Society, Feb. 17, 1930.

4. Dölter, W.: Monatschr. f. Kinderh. **34**:198, 1926.

5. Kreibich, C.: Deutsche med. Wchnschr. **52**:1044 (June 18) 1926.

6. de Potter, F.: Compt. rend. Soc. de biol., April 23, 1926.

7. Bardswell, N.: Tubercle **2**:433 (July) 1921.

that a tuberculin reaction has doubtful value and that the tuberculous eye subjected to such diagnostic means is seriously endangered. There is also the additional danger of a severe activation of an extra-ocular tuberculosis, particularly in a pulmonary process. If a focal reaction takes place in an eye, and if it is tuberculous, through an increase in the exudative process it will in all probability do more harm than good. The focal reaction in the tuberculous eye consequent on the use of tuberculin diagnostically (subcutaneously) should produce a severe exudation, which cannot improve the local inflammatory process. If such a reaction does take place and apparent improvement results, one may conclude that the process in the eye was most likely not tuberculous. Therefore, cases frequently reported in which a local, focal and temperature reaction was the result of the injection of tuberculin and in which the eye showed improvement must be seriously questioned from a diagnostic standpoint.

To maintain the premises on which the theory is based that tuberculosis of the eye is different from tuberculosis in other parts of the body would not appear to be consistent with modern conceptions of disease.

As to the therapeutic value of tuberculin for the eye, we must again refer the reader to authorities on tuberculosis. We have not used it at the Eye and Ear Infirmary for many years, nor at the Municipal Tuberculosis Sanitarium for a number of years. One of us (M. G.) questioned its value more than fifteen years ago and discarded it in the face of severe criticism. At that time, working on the pathogenesis of phlyctenulosis, we used tuberculin in many cases and found that its value was not to be compared with methods subsequently developed and reported.

The argument has been put forward by some writers that the value of tuberculin was probably the result of an allergy reaction. But just what is meant by an allergy reaction? Authorities on this subject neither agree nor are willing to make a definite statement.

The report of the Allergy Research Council [8] for the study of allergy stated that "statistics show that no immunologic theory of the past three decades has been more than 5 per cent clinically efficient."

From the preceding tables it would appear that tuberculosis of the eye was much less common than reports in the literature would indicate. The claim that tuberculosis of the eye was different than in other parts of the body would not seem consistent with our present knowledge of disease. Just how the eye may become infected with the tubercle

8. Recommendations of the Allergy Research Council of the Association for the Study of Allergy, J. A. M. A. **94**:654 (March 1) 1930.

bacilli, opinions differ, but why the eye seems immune to a tuberculous infection is an open question. The so-called tuberculous toxemia as the cause of ophthalmic tissue change does not seem to be demonstrated in our survey.

On this phase of the question Dr. Benjamin Goldberg [8] had the following suggestion to offer:

> The claim is made that this type of inflammation is the result of an allergy and is produced by a localization of tuberculotoxin floating free in the blood stream. It does not seem feasible, nor does our experience in tuberculosis, from an animal experimental or a human clinical research basis, allow us to consider such developmental processes. Allergy may have a place in the fixation of a tuberculous process, but it requires the presence of tubercle bacilli.

In our survey covering 1,073 cases of proved tuberculosis, in all of which the patient is or was toxic at some time, some of them extremely so, there seems to be no evidence that the lesions recorded were the result of a toxin. By far the greater number are unilateral and show a definite cleancut pathologic character. If the lesions had been due to a toxin, it would seem that we should have found more bilateral pathologic changes.

Therefore we must conclude that, to have a tuberculous lesion within the eyeball, there must be an implantation of tubercle bacilli. This implantation will result in one of two ways, depending on the resistance of the tissues invaded and on the virulence and quantity of the implant. If the invasion is a part of the picture of a general miliary or embolic tuberculosis (which is more common), death may result. If the implant consists of one or more bacilli or a small clump of tubercle bacilli that have gained entrance to the blood stream, there will follow a tissue reaction that will result in a tubercle formation which appears as an elevation. This elevation or tubercle will eventually be overcome by the host, or the host will destroy the invader. The changes described in our case reports we would be inclined to designate as the result of such an invasion in which the local host had overcome the invader.

It is our opinion, based on clinical experience and the evidence disclosed in this survey, that a tuberculous lesion within the eyeball is the result of such a clump of tubercle bacilli gaining entrance to the blood stream and acting as an embolus. This embolus must naturally be very small or it could not gain entrance to the fine caliber vessels of the eyeball. Our survey discloses that eighteen of nineteen cases, or 94.7 per cent, were unilateral, a phenomenon which would strongly favor the embolic implantation idea.

Having come to these conclusions, how can we account for or explain the small number of tuberculous lesions disclosed in this survey? We have been unable to find anything in the literature to answer this

question in what we are inclined to term a logical manner, consistent with the present knowledge of tuberculosis and in particular with the behavior of the tubercle bacillus.[9]

Does the eye possess a special immunity to the tubercle bacillus? This can hardly be answered in the affirmative, and yet the eye does possess something that affords protection or more authentic lesions of the eye would be found in the presence of an active tuberculosis.

When we speak of the defensive mechanism, as in tuberculosis, we have reference to the following: changes which play a rôle in cellular and humoral reactions, chemical changes and precipitin reactions, which to date are far from being on proved or practical grounds, so that we may dismiss this idea for the present. Can it be explained on an anatomic basis? This is debatable, but it does possess elements that are attractive, if not fact. One of us (M. G.) propounded the following theory which is here presented for consideration:

According to the best authorities on tuberculosis, the tubercle bacillus enters the organism through the respiratory tract and is distributed by way of the lymphatics. It may be distributed through the blood stream, but only when a lesion has invaded a blood vessel and entered the stream. Then it may act as an embolus and be localized anywhere. That being accepted as a fact, this question naturally follows: Are there any lymphatics within the eyeball? If there are no lymphatic vessels within the eyeball, then the answer becomes simple; that is, there being no lymphatic vessels within the eyeball, infection can take place only through the blood stream, and this must be in the form of an embolus.

Most authorities agree as to the absence of true lymphatic vessels within the eyeball, that is, provided one accepts the newer nomenclature and definition of what comprises a true lymphatic vessel. Lymph is a definite body fluid, transparent, slightly yellow and with an alkaline reaction; occasionally it is of a light rose color from the presence of red blood corpuscles, and it is often opalescent from particles of fat. A vessel is an elongated endothelial-lined tube. Consequently, when we refer to the lymph spaces of the eye, e. g., the chambers containing aqueous and vitreous, we are using terms that are misleading. Salzman[10] said:

> True lymph vessels occur only in the scleral conjunctiva, not, however, in the eyeball itself, nor in the orbit. On the other hand, larger spaces are present which among other purposes serve to a greater or lesser extent for the movement of

9. The literature is so extensive that we may have overlooked some paper on this phase of the subject.

10. Salzman, Maximilian: Anatomy and Histology of the Human Eyeball, Vienna, Franz Deuticke, 1912, pp. 185-186.

lymph. In this category belong the intervaginal space of the optic nerve, the perichoroidal space, and especially the posterior and anterior chambers.

The word lymph is frequently used in a general way, but, as a distinct body fluid, true lymph is found only in lymphatic vessels.

We may draw a conclusion from Weed's [11] report on the presence of lymphatic vessels of the brain. He presents a consideration of the spinal fluid, which is probably identical with the aqueous humor, and in addition a description of the embryologic development of the eye from the brain.

The lymphatics (?) of the meninges: This accessory or lymphatic pathway for the absorption of cerebrospinal fluid may be assumed to have its origin outside of the dura. This is substantiated by Sabin, who, in the course of many injections of the lymphatics of the head, never observed any evidence of lymph vessels in the dura or within its enclosed tissue. . . .

With the development of our present conception of the lymphatic system the absence of meningeal lymphatics has been proved.

SUMMARY

1. According to this survey, tuberculosis of the eye is encountered much less frequently than the literature would have one believe.

2. Of a total of 1,073 cases of proved tuberculosis, only 7 showed pathologic change in the iris, giving a percentage of 0.65 +. Only 3 of these could be seriously considered as tuberculous, giving a percentage of 0.27 +.

3. Of the 914 cases in which the fundus was examined, 78 showed deviation from the normal; only 19 of these can be seriously considered, giving a percentage of 2.08.

4. Of these nineteen cases, eighteen were unilateral and one bilateral, the latter probably of doubtful origin.

5. Tissue changes as the result of a so-called tuberculous toxemia were not disclosed in this survey, unless one considers the bleaching of the pigment as such.

6. Tuberculosis of the eye is in all probability the result of the localization of an embolic focus of the tubercle bacillus, which can take place only through the blood stream.

The opportunity for investigation was offered to us by Dr. Benjamin Goldberg, the medical director of the Municipal Tuberculosis Sanitarium; we were given the assistance and cooperation, at times under trying circumstances, of Dr. Peter S. Winner, medical superintendent of the Sanitarium, and the assistance of Misses Ruth Hack and Monica McHugh in the recording of our observations and history compilations during this survey.

104 South Michigan Avenue.

11. Weed, L. H.: Studies on Cerebrospinal Fluid, J. M. Research, September, 1914, pp. 88-89.

ABSTRACT OF DISCUSSION

DR. BENJAMIN GOLDBERG, Chicago: In ten years of consulting service at the Illinois Eye and Ear Infirmary and an experience of twenty years with tuberculosis, examination in many cases of suspected tuberculous conditions of the eye referred by the eye surgeons at this institution in no instance yielded a manifest extra-ocular tuberculosis. The eye is one portion of the human anatomy in which tuberculosis can be studied by direct observation. In the majority of instances, embolic implantation with tubercle bacilli, resulting in tubercle formation, should be determined directly. The supposed diffuse tuberculous uveal inflammatory reactions, based on the theoretical specific selectivity of free-floating tuberculotoxin from the blood stream, has no true pathologic or physiochemical basis as determined in animal or human experimentation. At least, one must conjecture that such tuberculotoxin must be produced in some tuberculous active lesion. A majority of suspected ocular uveal tuberculous lesions have disclosed no other tuberculous origin for such toxin. Tuberculin, diagnostically, is not absolutely specific. The percutaneous and cutaneous tests, such as the Moro, dermatubin and Pirquet, determine only the presence of an allergy, the result of previous tuberculous infection, and not actual tuberculous disease. The subcutaneous tuberculin reaction of Koch causes a threefold response: a local reaction, an inflammatory areola at the site of inoculation; focal reaction, an activation of the disease process and an increase of exudate at such focus, and a constitutional reaction, the result of absorption of toxins due to the activation of the focal process. In pulmonary tuberculous lesions I have seen grave consequences from such focal reactions and have therefore discontinued the use of this test. The same mechanism applied to the eye in tuberculous lesions should result in a similar outpouring of exudate, possibly with similar drastic consequences. The use of tuberculin in the therapy of tuberculosis has been discarded by the great majority of workers as having some danger and no appreciable value. If used, the dosage should be infinitesimally small within any possible point of allowing focal reaction.

DR. GEORGE S. DERBY, Boston: I want to congratulate the authors on their industry and on the time that they have spent in working up these statistics. I feel, however, that I must disagree with them on several of the data that they present. At the Dallas meeting of the Section on Ophthalmology, a paper by Brown and Irons on chronic uveitis was presented; and the incidence of tuberculosis given was extremely low—between 4 and 12 per cent. In the discussion I pointed out that in this disease the figures of the German observers were much higher, that they reached as high as 45 and 50 per cent, and that probably the truth of the matter lay somewhere between the two sets of figures. I continue to hold this idea. I have been greatly interested in tuberculosis of the eye. I feel strongly that there are many forms of tuberculosis of the eye which can be recognized clinically with a great deal of certainty after a good many years of experience. My experience is that, in these cases of ocular tuberculosis, active tuberculosis is seldom found in other parts of the body. Evidences of healed tuberculosis may be found, but it is the exception to find active, open tuberculosis. In regard to phlyctenular disease, the authors reiterate the view expressed by Goldenburg in 1917-1918 that phlyctenular disease had little or nothing to do with tuberculosis. I think that the evidence which has been presented in the last ten years tends to make that view more and more unsound. General opinion is coming more to the point that in some way phlyctenular disease is dependent on underlying tuberculous lesions.

DR. ARTHUR J. BEDELL, Albany, N. Y.: Tuberculosis, as it is seen in the fundus, can be diagnosed many times in the absence of other physical signs. I agree that more often it is seen without evidence of the disease demonstrable by the internist. I saw a boy who had poor vision in his right eye. He had a degenerative area in the retina. When next observed, six months later, there was a new lesion beside the old one. A large healed tubercle was found showing a thick pigment ring about a crater depression. An extremely interesting case showed a mere pinpoint of gray in the retina—the smallest tubercle ever diagnosed by photographs. The next three photographs made of the same patient demonstrated the development of this tubercle, with the distinctive vitreous haze, a curious translucence which is always suggestive of tuberculosis. This is the smallest tubercle that I have ever seen. The diagnosis could not have been made without the intense illumination of the photographic light. After ten months of local treatment there was a pigmented lesion and the translucent grayish-white area of a fresh invasion. A boy with tuberculosis complained one morning of cloudy vision. The photograph showed a new tubercle with a white indefinite border. A man who was about to die gave a picture of intense retinal and choroidal involvement. He had generalized tuberculosis. Twelve hours after this observation was made, he died. The changes in the blood vessels have been well explained by the work of Drs. Jackson and Finnoff. A woman, aged 30, seriously ill with tuberculosis, was confined to a sanatorium. When first observed, she had diffuse retinal hemorrhages; at the end of three months retinitis proliferans was far advanced. Her other eye was the same.

DR. F. H. VERHOEFF, Boston: Dr. Derby and Dr. Bedell pointed out that in a majority of cases of chronic ocular tuberculosis the internist discovers no evidence of systemic tuberculosis. That is undoubtedly true. In cases in which the internist has failed to find evidences of tuberculosis, I have examined enucleated eyes microscopically and found them to be tuberculous. I have also examined pieces of iris obtained by iridectomy for secondary glaucoma and have found that the iris contained tubercles. On the other hand, the converse is also true; namely, patients with active pulmonary tuberculosis are not likely to have ocular tuberculosis. When they do, the ocular involvement is apt to be of a severe type and lead to loss of the eye: massive tuberculosis of the iris or choroid. This is so rare that few ophthalmologists ever see it. For these reasons it seems to me unwise to draw the conclusion that tuberculosis is an infrequent cause of chronic disease of the eye.

DR. MICHAEL GOLDENBURG, Chicago: This survey discloses comparatively few tuberculous lesions of the eye in proved cases of active or of quiescent tuberculosis. To hold that the lesions are less frequently found in proved cases than in those which simply disclose a positive tuberculin reaction seems unreasonable and not based on sound medical teaching. Replying to Dr. Derby, the fact that German writers still classify phlyctenulosis as a tuberculous process does not make it so. Their evidence is no better than that of the eastern observers, which consists largely of a positive tuberculin reaction. It is time that this substance be dismissed as a diagnostic factor after the fourth year of life. In the May issue of the *American Journal of Ophthalmology,* Glover presented observations similar to ours and denied a relation between phlyctenulosis and tuberculosis, referring to it as an "ancient superstition." My first report on phlyctenulosis was made long before much was known about vitamins and was based on definite clinical observations, arrived at by a process of elimination therapeutically which included the use of tuberculin. Furthermore, I was able not only to clear up these cases, but

to precipitate them repeatedly by placing the patients on their former dietary regimen. This disease is usually described as due to a tuberculotoxin. No such evidence was disclosed in this survey. Answering Dr. Verhoeff, an eye lesion, the etiology of which is unknown, plus a positive tuberculin reaction does not prove that lesion to be tuberculous. That tuberculous lesions of the eye are rare in pulmonary tuberculosis has been found to be true, but it is our opinion that this apparent rarity is a true index of the frequency of actual tuberculous lesions of the eye. It is our opinion that a tuberculous eye lesion must be preceded by an implantation of tubercle bacilli with the formation of a tubercle and that this is the result of an embolic or miliary tuberculosis. It is remarkable that the great majority of physicians who devote their entire time to tuberculosis have discarded the use of tuberculin as a therapeutic agent and as a diagnostic factor after childhood. At the Illinois Charitable Eye and Ear Infirmary, a state institution, we have long ago discarded the use of tuberculin, but we do resort to nonspecific proteins.

Clinical Notes

KERATITIS POSTVACCINOLOSA*

A. A. Sinaiko, M.D., Stevens Point, Wis.

The following case is reported to emphasize the danger of not employing a protective covering following vaccination for smallpox, particularly in children. It also brings out the efficacy of physical therapy in recently formed corneal opacities, if used properly.

REPORT OF CASE

Joyce O., aged 6, white, was brought to my office on March 27, 1930, with the complaint that her right eye had been inflamed and sensitive to light for three weeks. The condition was first noted three days after she had been vaccinated for smallpox at school. At the start of this condition the family physician had treated her, but there was no improvement. The past history revealed no illness. The family history was unimportant. After vaccination no covering was put on the arm.

On examination, the left eye was normal. In the right eye, the lids were normal, but there was a moderate amount of inflammation of the palpebral and bulbar conjunctiva. On the cornea was a dull gray, cloudy, disk-shaped area. Its surface seemed to be somewhat roughened or almost stippled, but on close examination under magnification, this roughening was seen to be just under the outer coating of the cornea. The border of the cloudy area was well demarcated, except for a few small opaque spots about it. This opaque area was located almost in the center of the cornea and was about 5 mm. in diameter. The rest of the cornea was dull but not opaque. The fundus was normal. A general physical examination gave negative results. The patient seemed well nourished and otherwise healthy.

From a pathologic standpoint, the condition was ascertained to be keratitis disciformis. Later it was decided that it was so-called keratitis postvaccinolosa (a form of keratitis disciformis due to infection of the eye with vaccine virus). It was obvious that the patient had scratched the vaccinated area on her left arm with her right hand, and then had rubbed her right eye.

Hot wet dressings were applied to the eye after the application of the following ointment once daily at alternate intervals: yellow mercuric oxide, 2 per cent, and atropine, 1 per cent; 5 per cent solution of dionin was also dropped into the eye.

After the acute symptoms had subsided, thiosinamine ointment (10 per cent) was applied to the eye twice daily instead of the aforementioned ointment, and diathermy treatment was instituted on April 18. The purpose was to aid in the absorption of the corneal opacity which was still present, although it had localized more than previously. An alternating current was used. The small electrode was placed over the eye with the lids closed, and the large indifferent electrode was placed on the back of the neck. Two hundred milliamperes was given for

* Submitted for publication, Oct. 7, 1930.

ten minutes on the first day; this dose was gradually increased until the patient received 300 ma. for thirty minutes. Treatment was given three times weekly.

On May 2, after two weeks of diathermy, the patient was discharged. The cornea was entirely clear, no opacity remaining.

COMMENT

Keratitis disciformis is characterized by "an opacity caused by the necrotic part of the corneal parenchyma."[1] It was originally described by Fuchs in 1901. It is uncommon, usually attacking persons of middle age and usually leaving a permanent opacity of the cornea. It is thought to be due to an injury of the eye, followed by infection. A number of cases have been reported, however, following smallpox. Only one report is available describing the condition following vaccination for smallpox. This is by Schirmer,[2] who observed typical keratitis disciformis due to the infection of the cornea with vaccine virus.

CONCLUSIONS

It is evident from the history of this case that it is not advisable to leave areas vaccinated for smallpox unprotected, particularly in children. Although this complication is not frequent, its end-result is sufficiently serious to warrant taking this small precautionary measure in every case. It is also brought out that proper treatment with diathermy is of decided value in the clearing up of recent corneal opacities.

1. Fuchs, Adalbert: Atlas of the Histopathology of the Eye, no. 1, p. 13.
2. Schirmer: Arch. f. Ophth. **59**:133, 1904.

Ophthalmologic Review

INTRACAPSULAR CATARACT EXTRACTION

ITS PRESENT STATUS *

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PHILADELPHIA

The second best method of cataract extraction is capsulotomy; the first is the intracapsular method. Such is the opinion of Lieutenant-Colonel H. Smith. In his book on "The Treatment of Cataract," he stated:

> The time is now not far distant when Daviel's operation will be but a tradition of the Fathers and when Barraquer's vacuum spoon will share a shelf in the museum with all the varieties of Kalt forceps, there to be inspected as objects of historical interest. For the two methods which I have described of delivering the soft and hard lens by external pressure alone are so simple and so efficient that they are bound to prevail the world over.

A study of the intracapsular operation is not one of academic or scientific interest, but it has an important and practical application to every ophthalmic surgeon. Therefore, in order to determine, if possible, the attitude of ophthalmic surgeons both here and abroad toward the intracapsular operation, a study of the literature embracing the last ten years was made. In most of the current textbooks little space is devoted to this method of extraction, and no author appears to advise it. Many important questions present themselves:

1. Is the intracapsular operation supplanting the classic capsulotomy method?
2. What are its advantages and disadvantages?
3. What is its status among leading ophthalmic surgeons?

In this thesis the three leading types of intracapsular operations for cataract will be considered, namely, the Smith method, the Kalt forceps method and the Barraquer suction method.

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THE SMITH METHOD

The one outstanding man in a consideration of this subject is Lieutenant-Colonel Smith, now retired. He is "facile princeps" the man who has done most to advance this method, having performed over 50,000 intracapsular extractions himself. He has attracted a great deal of attention all over the world. So much so, that when he was at the height of his popularity many men journeyed more than half way around the world to study under his personal supervision. During the past twenty-five years his method has attracted much attention, created frequent discussions and received severe criticism. In 1905, he published his first paper in the American literature. The chief points of his technic are as follows:

The corneal section is finished in the clear cornea about 3 mm. below the limbus. Iridectomy is not recommended. An assistant is trained to hold the upper lid off the eyeball by means of a squint hook. Pressure is then applied through the heel of the squint hook over the cornea at the junction of the lower and middle third of the lens, and a spoon is placed just above the upper edge of the wound. Steady pressure is made with the hook until the lens is almost delivered from the wound. If the capsule bursts before the lens is delivered, Dr. Smith endeavors to remove it by using forceps. Escape of vitreous is not such a dreaded accident to his mind. Complications are rare, and visual results are excellent. The eye is not examined until nine days after the operation.

Smith used this method for all hard cataracts, but it could not be employed for morgagnian cataracts, as the pressure caused the cataract to rupture. He then adopted this procedure:

> In putting on pressure to make the soft lens turn a somersault [or to tumble, as he terms it], the hook is laid on the eye with the point as before over the junction of the lower and middle thirds of the vertical diameter of the cornea. The edge of the hook is made to grasp the corneoscleral ridge below. With this grip, he endeavors to pull the patient's eye toward his feet. The wound gapes, and the lens comes forward at its lower edge. When the edge is well advanced the pressure is released, the point of the hook is turned upward and follows the lens up, tucking the cornea in behind it. When the lens emerges from the wound, it is still attached above. The hook is then used to rake it aside.

Smith used these two methods to express the cataract in all his cases until 1921. However, as many of his followers had complained about numerous failures and serious losses of vitreous in attempting to remove hard cataracts by his method, he worked out a method of tumbling all hard cataracts by pressure from without in the following manner: Pressure is made at the lower end of the lens by means of the squint hook. At the same time a spatula, with its convexity backward, is placed over the incision to prevent the forward movement of

the upper border of the lens. The lower border will have no option but to come forward. The strain on the zonule is greatest below and it gives way here first, the lower border of the lens "tumbles" up, enabling the point of the hook to follow the lens up and out.

The important points of the Smith method are as follows:

Three-quarters of the battle in intracapsular extraction lies in making the incision properly. The knife should be held as one holds a pen in writing. To make the puncture, the knife should be entered with the edge turned forwards at a thirty degree angle. After making the puncture, the knife is driven across to the heel and the counter puncture is made. The handle is then depressed and the knife is now made to cut only the nasal side of the cornea. The heel of the knife now cuts the temporal side of the cornea. The incision should end in clear cornea. The size of the incision should be at least 180 degrees. A conjunctival flap is to be avoided. An iridectomy is not indicated. The lens is expressed by external pressure alone.

According to Smith, prolapse of the iris is not prevented by sutures or iridectomy. He tried using two corneal sutures and three peripheral iridectomies, at 10, 12 and 2 o'clock, respectively, but he saw no improvement, and gave them up.

Although he has performed more than 50,000 such operations, he has written little about his results, saying that this was not possible since most of his patients left immediately or soon after the operation. In 1905, he gave the results in 2,616 cases: first class results, 99.27 per cent; failures, 0.34 per cent; loss of vitreous, 6.87 per cent; uveitis, 0.3 per cent; ruptured capsule, 8 per cent; capsule left behind, 4.28 per cent. These operations were done during 1904 at his clinic in India. For his operation, he claims excellent results; iritis is rare; there is no after-cataract; iridectomy is not necessary, and loss of vitreous does not occur in a high percentage of cases. He concluded by challenging his opponents to produce better results.

Fisher has been one of Smith's strongest defenders in America. He visited Smith's clinic in India twice. In 1917, he published his book on "Senile Cataract," in which he gave his modification of the Smith method. To avoid any pressure on the eyeball, he invented the Fisher lid elevator to do away with the necessity of a trained assistant. He also used a Fisher needle for cases in which the lens presents in the corneal wound but will not come forward. The needle is stuck into the lens. More pressure is then made by the hook against the cornea until the lens is almost completely out of the wound. The lens is raked aside by the squint hook. If the capsule ruptures and retracts into the wound, an attempt is made to remove it by a large dissecting forceps. The use of the needle is supposed to prevent loss of vitreous.

In his book he gives the following results in ninety-four cases in which this technic was used: In seventy-four cases visual acuity equaled

20/30 plus; iridocyclitis occurred in three cases; glaucoma in four cases; choroiditis in five cases, and detached choroid in two cases. "In the writer's (Fisher's) opinion, all senile cataracts whether mature or immature would receive better visual results if operated by the intracapsular than the capsulotomy method . . . and the author's modification of the Smith technique has practically eliminated vitreous loss."

Knorr (1917) performed five operations using the Smith technic. The results were bad in all five, owing to loss of vitreous and drawn-up pupil.

A. S. Green and L. D. Green (1917) wrote that in their opinion the cadaverous types are the best for the Smith method. The older the patient, the better. The operation is contraindicated in juvenile, congenital and traumatic cases.

Although John Smith (1917) prefers the Smith method in cases of immature cataracts, he stated that it is unsafe in hypermature cataracts. In young patients and in patients with diabetes, hypertension and fluid vitreous, capsulotomy is better.

Santos-Fernández (1917) discussed the combined operation with a conjunctival flap as the "American method," and considered it a very safe procedure.

Mills (1917) expressed the belief that the capsulotomy method will continue to be the average operation of election because of its assured safety and universal application. He is of the opinion that the Smith method should be done only by men of large, constant, surgical experience and of keen surgical intuition. He performs the Smith operation and instils physostigmine (eserine) after the delivery of the lens.

Meding (1917) reported the results in eighty-three operations done by the Smith method. In fifty-three cases vision equaled from 20/20 to 20/40; in fifteen cases, 20/60. Iritis occurred in nine cases and prolapse of the vitreous in fourteen cases. He said that he prefers the Smith method to the forceps method, although he advises special training and experience.

Timberman (1918) advocated the Smith method, but he did not hesitate to use forceps if the lens fails to be expressed. If he lost vitreous, he did not seem to worry about it.

Allport (1918) thought that the Smith operation should never be attempted, especially by the general ophthalmic surgeon, and for this reason he believed that it will never become universal. It is complicated, difficult and dangerous. In America a lost eye is a serious thing, a Banquo's ghost ever ready to dismay and disquiet the surgeon. Instead of attempting this operation, why not devote one's energies to improve the capsulotomy procedure?

Jackson (1920) wrote: "Of devising many operations there is no end, and much study of them is certainly a weariness of the flesh. Ever since Daviel introduced cataract extraction, it has been the star operation of ophthalmic surgery." In his opinion, the great majority of ophthalmic surgeons have decided against the Smith method. Before any new procedure can be approved, each operator must carefully consider and decide whether it is a step forward. Jackson remarked that the objections to operations for secondary cataracts do not hold, since the introduction of the knife needle through the vascular limbus rather than the clear cornea has practically rendered the operation free from danger. Moreover, only one half of the cases require a second operation for secondary cataract.

Vail (1920) said that he prefers the Smith method. The chief points of his technic are as follows: The incision is corneal; iridectomy is performed; pressure is then made on the eyeball toward the optic nerve. If the lens fails to move, he stops the external pressure and uses his special forceps to tear away a large piece of the anterior capsule. The lens matter is then expressed. No irrigation of the anterior chamber is employed. He encourages all men who are doing the intracapsular method to continue.

Sternberg (1920) used the Smith method in twenty-three cases. He claimed to have obtained good results. In his opinion, iridectomy was not necessary.

O'Connor (1920) criticized the Smith method most severely, advocating capsulotomy or the use of Kalt forceps with iridectomy. In his forty cases, vision was 20/30 or better in 97.5 per cent. He compared his results with Green's series of 106 cases in which vision was 20/30 or better in 82.9 per cent. In Green's cases the percentage of serious mishaps was 45, while in O'Connor's it was only 10. In Fisher's ninety-four cases, vision was 20/30 or better in 72.5 per cent. O'Connor concluded that the intracapsular method of Smith cannot produce as good results as the capsulotomy method.

Hallett (1920) reported forty-eight cases in which the Smith technic was used. A preliminary iridectomy was performed in all but one. No flap was used. There was loss of vitreous in five cases; in forty-four cases the operation was successful; in 48 per cent vision was 20/20. Hallett is very favorable to the Smith method of extraction.

Henry V. Thompson and John W. Thompson (1921) called the Smith method propaganda and believed that most of his followers are inconsistent. Loss of vitreous is too frequent. Iritis and secondary cataract often develop. These authors prefer the combined method of extraction. In their forty cases, vision varied from 20/20 to 20/30; prolapse of the iris occurred in two cases and loss of vitreous in one.

In Green's 106 cases, there was loss of vitreous in 18; vision was 20/15 in 38 per cent, 20/20 in 23 per cent and 20/25 in 9 per cent. In O'Connor's 40 cases, vision was 20/20 in 72 per cent. They considered results, not methods, important. In their opinion, "the Smith operation has about closed its last chapter and finished its career in this country."

F. J. Pratt and J. A. Pratt (1921) published the results in fifty consecutive operations for cataract performed after the Smith-Fisher method, which is as follows: After the incision is made and iridectomy is completed, the lens is expressed according to the Smith method. If there is danger of loss of vitreous, the Fisher needle is thrust into the lens, the capsule ruptured and the lens delivered, allowing the capsule to fall back into the eye. The iris is then replaced. The lens is delivered under the upper lid. The Fisher needle was used in six cases. The vision obtained was 20/30. The capsule ruptured in three cases; there was prolapse of the iris in four and loss of vitreous in seven. In 83 per cent, the cataract was delivered in the capsule. In thirty-one cases, vision was 20/40 or better. Dr. Spratt of Minneapolis, in discussing this paper, said that this operation is not the choice of the majority of the leading American and European operators; he stated his preference for the combined operation.

Veasey (1921) wrote, "It is my conclusion that extraction in the capsule is not adapted to the American people. Nor is it the safest procedure; i. e., the one that will produce the best results for the greatest number of patients in the hands of the average operator in private practice."

King (1921) stated that many of the Smith features can be incorporated in the classic operation.

Holland (1922) stated that he used the intracapsular method in 95 per cent of his cases. He said that the objections to the operation are due to its difficulty of performance—its need of special trained assistants to handle the lids requiring very efficient men, since the success of the operation may depend on this assistance—and to the loss or fear of the loss of vitreous. He said that the intracapsular operation must not be employed in all cases. Smith clearly indicated the cases which are unsuitable for intracapsular extraction: (1) all cases of congenital cataract, (2) juvenile cataract in persons up to 30 years of age and (3) secondary or after-cataract. Holland goes further and prefers to do a capsulotomy on patients with large, prominent eyes—"ox-eye types" he calls them—on account of the danger of loss of vitreous and in some cases that do not respond to legitimate pressure. In some patients between 30 and 50 years of age who appear robust and well nourished, the zonule is tough and difficult to rupture without danger of losing the vitreous; in these, capsulotomy is preferable. In cataract with

glaucoma, Holland said that he preferred capsulotomy. In traumatic cataract, capsulotomy is advisable, and there is less possibility of loss of vitreous. Holland stated that it is important to know when to use the capsulotomy method and when the intracapsular procedure is the method of choice. In his opinion, 95 per cent of all cataracts can be extracted successfully by the Smith method.

Strother Smith (1922) dismissed the objection that the Indians are better patients than the Europeans. He said that there is too much preliminary meddling and elaborate preparation, and that the patient enters the operation room in an apprehensive condition. Some failures are due to faulty technic, a small incision, poorly trained assistants and improper or misdirected pressure on the lens. He is an enthusiastic supporter of the Smith method, and believes that the capsulotomy method is dying a natural death. He does admit, however, that the capsulotomy method is easier, and that the more difficult intracapsular method requires more training.

McReynolds (1922) presented some interesting observations on the status of intracapsular operations in America. The responses received from his questionnaire, sent to practically all the leading ophthalmologists, showed conclusively that the majority of the surgeons were not doing any form of intracapsular operation. The report also showed that some of the leading men did not operate on more than fifty patients a year. The report indicated that it is hopeless to expect that this method of extraction will be adopted as a universal procedure among American surgeons. His report goes into intimate details as to the method of procedure, such as fixation of the globe, iridectomy, etc. He asked Smith whether his procedure should be adopted as a routine method by the average American ophthalmic surgeon. His reply was "no." Smith believes that the intracapsular extraction of cataract is a specialty within a specialty, and that the surgeon must have confidence, surgical judgment, proper training and common sense that can be depended on to modify immediately any procedure to meet an emergency. McReynolds does not advocate this method for young surgeons, but advises familiarity with every phase of capsulotomy extraction. Later the intracapsular method might be adopted in favorable cases, and as the surgeon grows in experience and proficiency, he should be able to drop the old method and adopt the more difficult intracapsular technic.

The questionnaire showed that nineteen men were using the intracapsular method in nearly all cases of cataract; twenty-one used it occasionally, and sixty-three men did not use it at all. Among them were many leaders in ophthalmology, not only in America but throughout the world. After reading the answers to this questionnaire, one

cannot doubt that intracapsular extraction is not the usual method employed by American ophthalmic surgeons.

McReynolds believes that the intracapsular extraction is an ideal operation if successful.

Hardy (1922) reviewed the results of Smith's visit to St. Louis. These results were poor. Smith made few converts during the visit, because the operation caused too much trauma; the loss of vitreous was too high; the corneal incision was difficult to heal on account of the drawn-up pupil and incarceration of the iris. Forty patients were operated on by Smith. The results in thirteen cases were as follows: vision was 6/6 in two cases, 6/9 in four cases, 6/13 in five cases and 6/15 in two cases.

Zentmayer (1922) reported the results of operations performed by Smith at the Will's Hospital. The favorable features were the flushing of the culdesac, the control of the orbicularis muscle, and the manner in which the lids are held away from the globe. The disadvantages were the too strong solution of mercuric chloride, insufficient anesthesia in some cases and the method of making the corneal section. The visual results were as follows: 6/6, two cases; 6/12, two cases; 6/15, three cases; 6/20, four cases; 6/30, two cases. Loss of vitreous occurred in 38 per cent and incarceration of the iris in 38 per cent. In most of the cases there remained either vitreous haze or definite vitreous opacities. The results were poor.

Paul Knapp (1923) of Basle, Switzerland, described modern capsulotomy as his preference. He considers any form of intracapsular operation too dangerous. In his opinion, the Smith or Barraquer methods offer nothing new or better.

Barkan (1923) reviewed the operative results of Professor Meller of Vienna from 1919 to 1921. The capsulotomy method with peripheral iridectomy was used in 249 cases. One hundred and eleven of the patients returned for final examination; in 95 of these vision was 6/12 plus without discission. "Not until the adherents of the intracapsular method have worked up thoroughly and checked accurately the results of 20,000 cases, can there be any basis for discussion. The method that gives the great majority from 20/20 to 20/40 vision will remain the method of choice until a safer one than the Smith or Barraquer method is devised." He quoted Parker, who believes that the intracapsular procedure must stand the test of comparison with the combined method performed on patients selected with equal care. There was 5 per cent loss of vitreous for all cases.

Dorland Smith (1923) remarked that "the character of the cataract should determine the method of extraction rather than our enthusiasm

for any one method of procedure." A routine method is not good surgery in his opinion. The age of the patient, the type of the cataract and the training of the operator must be considered. In children there are three types of cataract: membranous, milky and jelly-like. The membranous cataracts are extracted with forceps; the milky ones are needled, and linear extraction is used for the others. In patients over 18 years of age, linear extraction can be used. Senile cataracts demand more attention. In all patients under 60 years the zonule is tough, and for young surgeons capsulotomy is safer. Cataracts in children are not suitable for extraction in the capsule. In the mature type, any method can be used. In a hypermature type with thin, flattened lenses, traction is ideal. In sclerosed lenses, capsulotomy is safer for some operators; for the experienced, the Smith operation is ideal. In high myopic eyes, capsulotomy is preferable. In glaucoma with posterior synechiae and tendency to focal infection, intracapsular extraction is ideal. In the case of a dislocated lens, the Smith method is preferable. In prominent bulging eyes, capsulotomy is advocated. In poorly nourished patients with deeply sunken eyes, the intracapsular method is safe. Smith practices the Smith-Indian method and considers it ideal.

Fisher (1923) reported the results of Smith's visit to Chicago. Smith operated in thirty-one cases; in over 60 per cent vision was 20/30. In this paper, Fisher said, "The surgical results are often more interesting and instructive than the visual results."

Giri (1923) used the Smith method in 384 cases in India. Loss of vitreous occurred in 20 per cent and prolapse of the iris in 8 per cent. The vision was 6/6 as a rule. These results appear remarkable.

Judkins (1924) gave the results of seventy-five cases in which the Smith method was used. In 73 per cent the vision was 20/40 plus; loss of vitreous occurred in 22 per cent. There was no iritis or secondary cataract. Judkins is also enthusiastic about this method, and believes that it will become universal.

Holland (1924) reported the results in 100 patients operated on in one day at Shikarpur, India, by the Smith method. He is inclined to favor this method because patients do not have to wait, postoperative inflammation is unusual, and better results are obtained. Loss of vitreous occurred in 12 per cent, prolapse of the iris in 3 per cent and ruptured capsule in 9 per cent. He obtained good surgical results in 92 per cent of his cases.

McPhail (1925) recounted some of his personal experiences in India. He tried the Smith method, but gave it up as he lost too much vitreous. At present, he performs the capsulotomy operation, using the

knife to open the capsule "chemin faisant." No statistics or results of operations are given, as the patients were pilgrims who left soon after the operation.

Patterson (1926) is also enthusiastic about the Smith method. He reported the results in eight cases. Vision in four cases was 20/20. By adopting this method, there is no delay or idleness for the patient, since the lens can be removed before maturity of the cataract.

Birch-Hirschfeld (1927) described the method used at the Eye Clinic of Königsberg for removal of cataract. The review covers a period of the preceding eight years. The classic capsulotomy with a Hess iridectomy was used in 1,816 cases. No results are reported.

A. E. J. Lister (1928) examined ninety-eight patients who had lost vitreous during their operation by the Smith method. In five patients who had lost the largest amount of vitreous, the vision was 6/6 plus. In 62 per cent, the vision was 6/6 or better. The average elapse of time was four years. No case of retinal detachment was seen. Lister maintains that the loss of vitreous is not detrimental to good vision. The poor results are due to iritis and iridocyclitis.

Nanharya (1929) gave the results of 100 cases of cataract extraction in which the Smith method was used. The patients were natives of India. Contrary to Smith, he uses a conjunctival flap in all his cases. Loss of vitreous took place in 10 per cent; the capsule ruptured in 4 per cent, and there was prolapse of the iris in 1 per cent.

Meding (1929) is a staunch supporter of the intracapsular method. He prefers the sclerocorneal section and peripheral iridectomy. He uses the method of Kalt to do the iridectomy. He admits that dislocation requires force. His modification of the Smith method is to apply the knee of the hook to the sclera down in the inferior fornix while pressure is exerted over the section with a spatula toward the center of the globe. Slowly the hook is moved forward toward the sclerocorneal margin. The lens begins to rise at its lower border. The spatula is removed, and the hook follows the lens upward tucking the cornea under the lens. The iris is replaced after the lens is removed.

THE BARRAQUER METHOD OF CATARACT EXTRACTION

The next important method of intracapsular extraction to be considered is the Barraquer or suction method. In 1917, Barraquer of Barcelona first described his operation in detail. "Facoerisis," wrote Barraquer, "consists in drawing the crystalline lens by its anterior surface, separating it mechanically without either traction or violence to the zonule and extracting it completely out of the eyeball, without having produced ectopias or traumatism to the intraocular structures." The apparatus used is essentially a pneumatic forceps called the erisifaco

which is connected to a vibratory pump. The pump produces the suction. The details of its construction will not be dealt with in this paper.

The essential points of his technic are as follows:

1. The pupil is dilated by using a few drops of euphthalmine.

2. The section embraces two fifths of the corneal circumference and ends with a small conjunctival flap.

3. A peripheral iridectomy is performed.

4. The suction cup is then introduced into the anterior chamber behind the iris and is placed on the lens surface.

5. The lens is removed by rotating it on its transverse axis, causing the inferior border to rise and come forward. The posterior surface of the lens remains in contact with the posterior surface of the cornea until it is removed from the wound. No pressure is exerted on the eye at any time.

TABLE 1.—*Barraquer's Results in One Thousand Cases*

Hernia of vitreous	7 cases
Inversion of iris	2 cases
Capsule torn	4 cases
Luxation of lens	3 cases
Hernia of iris	7 cases
Hemorrhages into anterior chamber	5 cases
Expulsive hemorrhage	1 case
Extraction with iridectomy	530 cases
Combined extraction	231 cases
Visual acuity	60.4% was 0.7 to 1
	24.0% was 0.3 to 0.7
	7.0% was 0 to 0.3

6. The iris is then replaced and 0.5 per cent physostigmine (eserine) ointment is instilled. The eye is kept bandaged for one week.

Barraquer (1920), using the foregoing technic, reported the results obtained in 1,000 cases.

In this paper he said that he believed that the corneal incision was preferable to the sclerocorneal incision.

Barraquer (1921) again described his operation in detail. To him the chief advantages of his operation are that the number of maneuvers within the eye are reduced to a minimum; only one instrument is used, and no second operation is necessary. He compares his forceps to a zonulotome, believing that the vibrations produced by the pump rupture the fibers of the zonule. The operation is simple and easy if his instructions are carried out.

Gallemaerts (1921) reported the results in twenty-four cases in which the Barraquer method was used. There was one case of ruptured capsule and two cases of prolapse of the iris. The vision was 0.5 or better in every case. He believes that a great future awaits this operation.

On his return from Barcelona, Professor Turc of Montpellier asked him the old question, "If you had a cataract would you want the Barraquer method performed?" "Yes," he answered, "provided Barraquer did it."

A. S. and L. D. Green (1921) modified the Barraquer apparatus, having a foot control for the suction. They also used pressure on the limbus by means of a specially designed forceps to help extract the lens. They combine expression with traction. No mention of iridectomy is made in their paper. This method was used in over 100 cases, but no results are given. Congenital, juvenile or traumatic cataracts are not suitable cases for this method. They admit that greater skill is demanded in any intracapsular extraction than is necessary in capsulotomy.

Barraquer (1922) again described the principal points of his technic, which are similar to those of his early method. He does not advocate this method for patients under 40 years of age, in complicated cataracts or in patients with high myopia, in subluxated lenses, in traumatic cataracts or in cataracts ripened artificially. Despite all the objections against his method, he claims that he has obtained better results and fewer postoperative complications than he did with the cystotome.

McReynolds (1922) made a visit to Barraquer's clinic and gave a description of his technic.

Greeves (1923) reported the results obtained in fifty-one cases in which this method was used: Thirty-one cases were successful; in seven, the capsule broke, thirteen were unsuccessful, three showed loss of vitreous, nine showed prolapse of the iris.

The vision in thirty-seven cases was 6/9 or better. He is favorable to this method especially for immature cataracts. He admits that this method "has shown itself to be less certain in its results than extraction without the capsule."

Chapman (1923) uses the Barraquer method, but believes that iridectomy is contraindicated.

Zentmayer (1923) reported the results of ten operations performed by Barraquer at the Wills Hospital. Loss of vitreous or incarceration of the iris did not occur. Visual acuity was 6/6 in one case, 6/9 in three cases, 6/12 in one case, 6/15 in two cases, 6/60 in one case. In discussing the Barraquer method, he remarked, "If any intracapsular method is desirable it would seem to the writer that one which avoids undue pressure on the hyaloid should be the method of choice. Such we have in the Stanculeanu forceps method or in one of its modifications such as Knapp's."

Ubaldo (1923) reported the results in ten cases in which the Barraquer method was used. In six cases the vision was 20/40 or better. Ubaldo favors this method of extraction.

Mills (1923) visited Barraquer's clinic and came to the conclusion that any intracapsular operation must stand the test of comparison and must give better results in the hands of the average operator before it can meet with general acceptance.

Moore (1923) performed thirty-eight operations with the Barraquer technic. The pupil was dilated with homatropine and a complete iridectomy was done. In twenty-seven cases the operation was successful and in nine cases there was loss of vitreous. The advantages of this method, in his opinion, are that a round black pupil is secured; immature cataracts can be removed; there is no danger of capsular tags in the wound, and no secondary operation is necessary. The disadvantages are the frequency of loss of vitreous and incarceration of the iris; the loss of support for the vitreous and the frequency of striate keratitis. No visual results are given. His opinion of the operation is as follows:

> My feeling is that the operation has such a considerable element of danger in it (especially in the form of vitreous loss and its consequences) that for general use it is inferior to the older method. I think this inferiority is especially marked in the case of cataracts which are mature or hypermature. On the other hand, for immature and sclerosed lenses it has a distinct advantage of its own and it may be that an extended experience may result in the permanent adoption of Professor Barraquer's operation for these types.

Hepburn, in discussing this paper, said that this method will not supplant the capsulotomy method.

McLean (1923) visited Barraquer's clinic and adopted this method of extraction. He agrees with Gallemaerts that it is not wise to attempt to do this operation without having first made a pilgrimage to Barraquer's clinic.

Barraquer (1924) reported that it is unusual for him to obtain a visual acuity of less than 0.8. His technic shows no important change from that described in his earlier papers.

Sinclair (1924), in discussing Barraquer's method, stated the belief that his specially designed forceps method is better than the Barraquer method. His forceps have a double cross action. Smith does not believe that the vibrations which Barraquer describes play any part in dislocating the lens. Moreover, he maintains that the incision must be at least 180 degrees and not two fifths of the circumference (144 degrees) as Barraquer advises. Harmon favors the capsulotomy method. Harrison Butler said that he saw no reason to change from his present custom of employing capsulotomy. Whithead said that he favored the capsule forceps method rather than the Smith or Barraquer operations.

Ubaldo and Fernando (1924) reported thirty cases in which the suction method was used. Peripheral iridectomy was used in all the cases. In their opinion, this operation is better than the Smith method.

Higgins (1925) used the Barraquer method in eleven cases. He obtained good results and concluded that this method is much safer than the Smith procedure.

Bagot (1925) wrote of his experiences at the Barraquer clinic both as a patient and as an observer. This operation was performed on his own eyes at an interval of two months. After the operation he was able to read, write and drive his car well. He believes that Barraquer has devised a marvellous operation. He calls it "le plus grand perfectionnement."

Cruickshank (1925) published a detailed paper on the Barraquer technic as he employs it. He reported the results of 115 consecutive cases: Very good vision in 76 cases; very good vision with complications in 10 cases; very poor results in 8 cases and ruptured capsule in 15 cases. In his opinion, the type of patient in India is much different than the average American or Englishman. The patients are not able

TABLE 2.—*Comparative Results in Cataract Operation at Elschnig's Clinic*

	Capsulotomy	Smith	Stanculeanu	Török	Barraquer
Number of cases.....	1,000	44	35	46	76
Loss of vitreous.....	1.9%	20%	11%	9%	10%
Prolapse of the iris....	2.2%	10%	9.5%	1.5%	2.7%
Secondary cataract....	5.8%	0	0	0	0

to be followed up or the results studied. He believes that the Barraquer method is superior to the Smith.

Elschnig (1925) reviewed the results of the different types of cataract operations performed in his clinic. These are given in table 2. He felt justified in expressing an opinion that the Barraquer method of extraction is by far the best method of intracapsular extraction, especially in immature, hypermature and juvenile cataracts. This article is a fair analysis and attempts to answer the question impartially. While favoring the suction method, Elschnig remarked, "For a simple senile cataract in the stage of maturity or in the transition from the immature to the mature state or in the transition from the mature to the hypermature stage, the usual extraction with capsulotomy is to be preferred to the intracapsular extraction." He attempted the Stanculeanu-Török method to remove the lens, but after doing this operation he came to the conclusion that loss of vitreous and prolapse of the iris were too frequent to recommend as a universal procedure. However, as will be seen later, Elschnig became quite a supporter of the forceps method of extraction.

Wright (1925) reported the results in 259 cases in which the Barraquer method was used, and compared his results with those obtained at the Madras Hospital. These results show that those

obtained with the Barraquer method were much more unfavorable than those obtained by capsulotomy. While favoring the suction method, Wright remarked that it is not suitable for bulging eyes, friable capsules, immature cataract or morgagnian cataract. He always practices a peripheral iridectomy in his cases. He raises some important questions as to the value of any intracapsular operation on the vitreous, since in any such operation the vitreous body is deprived of the support of the suspensory ligament and capsule which prevent the invasion of the vitreous by cell elements that cause opacities of the vitreous. The frequent hernias of the vitreous into the anterior chamber, the effect of the aqueous on the vitreous, the damage to the ciliary epithelium, the danger of organized opacities of the vitreous, which may be progressive and incurable, are to him important considerations which may develop after any intracapsular operation. He urges further studies on the vitreous to determine whether any changes occur.

TABLE 3.—*Comparison of Results in Cataract Operations Given by Wright*

	Barraquer	Simple	Capsulotomy
Number of cases	250	406	873
Failures	6	1	8
Loss of vitreous	23	4	19
Visual acuity: 6/36 or better	201	370	754
6/36 to 2/60	22	25	64
2/60	20	10	45

Hume (1926) advocated the Barraquer operation in certain types of cataract. He uses Greens' modification of the Barraquer apparatus. In his opinion, the vibrations described by Barraquer play no part in dislocating the lens.

Van Lint (1926) uses his own modification of the Barraquer technic. He employs a lateral section of the conjunctiva and cornea. This is begun by a keratome and completed by the scissors, which extend the incision above to the vertical meridian and below to the vertical meridian. The section is in the outer half on the cornea and faces the external canthus. The suction cup is then used to extract the lens. Several sutures (five) are used to close the incision. By this lateral section, he claims that the Barraquer suction apparatus can be more easily and safely introduced and the rotation of the lens on its transverse axis can be performed more naturally. He remarks that the majority of physicians have abandoned retrobulbar injection because of the danger of paralysis of the extra-ocular muscles. To this statement many will take exception.

Cruickshank (1926) stated that iritis is usually due to retention of lens protein in the anterior chamber. In 113 cases in which the Barraquer method was used, iritis occurred in only 3 per cent.

Nugent (1926) stated the belief that retained cortex frequently causes postoperative intra-ocular inflammation, and for this reason he favors the Smith or Barraquer operation. He prefers the Barraquer method, and believes that it will supplant all others.

Fisher published an article on phaco-erisis in 1927, and believed that is was the best method for all kinds of cataracts except dislocated lenses. The operation is not simple, as is capsulotomy. It requires special training. He is not in sympathy with the forceps method of extraction.

Cruickshank (1927) reported a series of cases from the clinic at Shikarpur, India. Over 4,000 persons were operated on for cataract during 1923 to 1926. No attempt to compare the different methods and results was made. The Smith method was used in 3,639 cases, Barraquer's method in 214 and capsulotomy in 174.

Russel Smith (1927), who is the son of Lieutenant-Colonel Smith criticized in detail the Barraquer operation. In his father's book on senile cataract, he devotes over 100 pages to prove that the suction method as advocated by Barraquer cannot be properly done if his technic is followed out. He accuses Barraquer of bad faith, saying that he writes one thing but does another. His chief arguments against this method are:

1. The apparatus is not scientifically correct.
2. In practice the instrument does not work well.
3. The vibrations which Barraquer holds responsible for rupturing the zonule play no rôle at all.
4. Barraquer dislocates the lens by pushing it back into the vitreous before attempting to rotate it.
5. The erisiphaque is nothing but an instrument which first dislocates the lens and then pushes it out of the globe.
6. The incision as recommended by Barraquer is too small to allow the lens to escape.

Van Lint (1927), in a paper read before the Barcelona Ophthalmological Society, gave the results of his experience with the Barraquer method. He said that he had practiced the classic capsulotomy method for many years, that he had no time for the Smith operation, and that he believed it should be abandoned. In 1922, he related his experiences with the Barraquer technic. At that time he was discouraged with his results and abandoned it. The fact that the patient had to rotate his eye downward in order to introduce the erisiphaque exposed the eye to loss of vitreous. In 1927, he again reported his results with the Barraquer technic. By this time he had made several important changes in the operation. He employed deep anesthesia, a conjunctival flap and made the section in the outer half of the cornea. The suction cup was then introduced from the side. The incision was closed with five

sutures. "I am convinced," he remarked, "that the lateral intracapsular extraction for simplicity, facility and its excellent results will rapidly be adopted and will cause the capsulotomy method to be abandoned. It is indeed the operation of the future." (Il est donc l'opération de l'avenir.)

Wolfe (1928) reported five cases in which the Barraquer method was used. He obtained very good results in all of his cases. He advises a peripheral iridectomy for all cases. In 1928, he wrote that this method is the best operation for cataract extraction. He uses Greens' modification of the Barraquer apparatus.

THE FORCEPS METHOD OF INTRACAPSULAR EXTRACTION

One of the most popular methods of intracapsular extraction at the present time is the forceps method. In 1910 Kalt called attention to his method of cataract extraction. At that time he wrote:

> A step forward in the technique of the operation of cataract will be realized the day when one is able, without injury to the vitreous, to remove the capsule at the same time as its contents. The removal of a portion of the anterior capsule large enough to allow the lens substance to escape approaches this ideal. The advantages are the easy evacuation of the soft masses which are no longer retained in the equatorial region of the capsule and also the removal of the epithelial remains which have the bad tendency to proliferate after the extraction.

For this reason he devised his blunt forceps to grasp the capsule but not to tear it. Previous to this time the forceps employed had teeth. Kalt appears to be the first one to suggest the idea of using blunt forceps to extract the lens. His forceps were blunt, and at the open end their shape resembled a half moon. In one case the lens and capsule were removed in toto. He had used this method in over 100 cases and was greatly pleased with his results. Secondary cataract was infrequent, and visual acuity was much better. At this time he gave no results or statistics of his cases.

Stanculeanu, in 1912, wrote an interesting paper describing his technic. He had performed the Smith operation in twenty cases but was not pleased with his results. He criticized the operation because of the too violent pressure on the eye which often caused opacities of the vitreous, choroidal hemorrhage and drawn-up pupil. He believed that Smith's results were not correct as the patients often showed poorer vision some months after the operation. In 1910, at the Heidelberg Congress, he described his technic, which he used in thirty-seven cases. On the evening preceding the operation, a few drops of 1 per cent homatropine were dropped into the conjunctival sac. The section was made in the limbus. A small curved forceps (resembling von Graefe's iris forceps) was then introduced into the anterior chamber unopened.

The forceps were applied to the anterior surface of the lens and then opened, and by slight pressure backward a piece of the anterior capsule was grasped. By an up-and-down motion the lens was dislocated from the zonule. As soon as this was accomplished the forceps were withdrawn, the lens remaining behind. With two spatulas in the usual position the lens was then expressed. The iris was returned to its former position. A 1:100 solution of physostigmine salicylate (eserine salicylate) was then dropped into the eye. Later he added a small iridectomy to this procedure. From June, 1910, until December, 1911, this type of operation was performed in 240 cases; of this number, 137 cataracts, or 58 per cent, were extracted in the capsule. Stanculeanu observed that proper light was necessary in order to see the field of operation clearly; also, the older the patient, the easier the lens is extracted in its capsule. In some cases the capsule tore easily; in others it was impossible to keep a hold on the capsule. In some cases the capsule was adherent to the patellar fossa and had to be extracted by the capsulotomy method. If the capsule did not tear, a special toothed forceps was used. In two cases he had loss of vitreous; glaucoma and drawn-up pupil occurred in three cases. He believed that his results were good as, if not superior to, the other forms of intracapsular operation. His conclusions were that no method is universally applicable to all cases, and that Smith's operation is too dangerous. With his own method from 60 to 70 per cent of the cases of cataract can be extracted in the capsule, and in cases in which the capsule tears, a toothed forceps can be used to do a capsulectomy, the lens matter being allowed to escape.

Knapp (1912) visited Smith in India and observed his method. After returning home, he attempted this operation, but abandoned it because of failure. He then tried the Kalt method to dislocate the lens. This method succeeded in about 50 per cent of the cases; it failed when the capsule was thin. He found it adaptable in hypermature cataract and sclerosed lenses. He performed ninety-four operations in this manner. In sixty-five cases, the visual results were 20/40 plus. Loss of vitreous occurred in fifteen cases; prolapse of the iris in six and iridocyclitis in eight.

Verhoeff (1915) prefers the forceps method of cataract extraction, using a modification of Kalt's forceps to dislocate the lens while external pressure is applied on the cornea below as in the manner of Smith's method. He recommends an iridectomy but no flap.

Knapp (1917) reported the comparative results obtained by several different physicians using different methods. In 52 per cent of 1,000 cases in which capsulotomy was performed by Herman Knapp, vision was 20/40 or better. Weeks, in 1895, reported results in 100 cases.

Vision was 20/40 plus in 62 per cent. Smith, in 1905, published the results in 2,616 cases. Excellent results were obtained in 99 per cent. In 1912, he added 132 more cases with visual results of 6/9 plus in 97 per cent.

From this comparison, it appears that the results obtained by the Smith method were much better than those obtained by capsulotomy. Nevertheless, Knapp objects to the method because of the necessity of a trained assistant; the corneal section is slow to heal, and loss of vitreous is a great danger. This is not so when capsulotomy is employed. Moreover, Knapp believes that iritis is not caused by retained lens capsule, and that in cases of intracapsular extraction hemorrhage into the anterior chamber is slow to absorb. Knapp gave up the Smith method, fearing that it required too much pressure, and he attempted to dislocate the lens by using a smooth Kalt forceps. If the zonule is weak the lens is delivered in its capsule; if not, the anterior capsule is torn away and the lens is delivered as by capsulotomy. No trained assistant is necessary,

TABLE 4.—*Comparative Results in Cataract Operations Given by Knapp (1917)*

	Number of Cases	Visual Results
Green and Millete	203	73% — 20/40 plus
Fisher	94	80% — 20/40 plus
Knapp (1915)	100	92% — 20/40 plus

and the lens is made to tumble, helping to prevent loss of vitreous. Török, in adopting this method, applied pressure at the lower part of the cornea while dislocating the lens. Knapp wrote to nine oculists who had been trained under Smith, and asked them if they were still using this method. Eight replied that they were using the Smith method and believed that it surpassed all others. Fisher replied that it was the best method yet devised, but added, "We should attempt to devise a method less dangerous to the eye than the Smith method."

Benedict (1919) used the Kalt forceps in twenty-four cases and was greatly pleased with his results. Iritis was rare; there was no secondary cataract and no complications. In his opinion, it is the best operation for the aged, since the time of convalescence is shortened.

Parker (1920) reported his observations on 1,184 cataract operations. No results are given in his paper. The cases were divided as follows: combined extraction, 936 cases; simple extraction, 154 cases; Smith, 89 cases; Knapp, 25 cases. From his observations he believes that the combined operation with the flap is the most acceptable procedure to the majority of surgeons. In the Smith operation, there is danger of loss of vitreous and drawn-up pupil. The Knapp forceps method is to him the best intracapsular procedure.

Knapp (1921) wrote that the manner of dealing with the capsule causes the most divergence of opinion. He described three procedures: the capsulotomy, the toothed forceps and the blunt forceps. The type of cataract and the behavior of the patient are important. He assumed that an iridectomy is always performed. He uses the Kalt blunt forceps to dislocate the lens. If the capsule is not ruptured, the lens may be dislocated. The larger the knuckle of capsule grasped, the less likely is it to tear and the more likely is the lens to be dislocated. The more mature the cataract, the easier the dislocation. After the cataract is dislocated, the forceps are released, and extraction in the capsule proceeds according to the Smith technic. The blunt forceps were used in 214 of 300 cases; the capsule ruptured in 125. The toothed forceps were used in 51 cases; extraction in the capsule in 89, and the cystotome in 35. Loss of vitreous was seen in 9 per cent. Knapp tried the Török modification, but found that it was not as good as his own method.

TABLE 5.—*Comparative Results in Cataract Operations from the University of Michigan*

	Combined	Simple	Knapp	Smith
Number of cases	1,013	156	49	91
Vision, 6/12 plus	43%	31%	59%	41%
Loss of vitreous	10%	6.4%	10.2%	19.7%
Failures	2.2%	....	0.2%	6.5%

Knapp reported the results in another 100 cases in which the Kalt forceps method was used. Loss of vitreous took place in nine cases; prolapse of the iris in 4 per cent; no case of ruptured capsule was seen. The visual results were good. In 43 cases vision was 20/20; in 14, 20/30; in 14, 20/40 and in 4, 20/50. No cases of secondary glaucoma were seen later. He believes that this method should be the goal of all operators.

Greenwood (1921) uses the Verhoeff smooth forceps. After making a medium-sized iridectomy, he inserts the forceps and grasps the capsule at its center or slightly above. A gentle rocking motion is employed. In the majority of cases the lens comes away with very little trouble. He reported the results in twenty-two cases. Twenty-one were successful; in one the capsule was torn; loss of vitreous occurred in two cases; in nineteen vision was 20/30 or better.

Parker (1921) reviewed the results of 1,421 cataract operations performed at the University of Michigan clinic from October, 1905, until January, 1921 (table 5). He agrees with Knapp that "the lens cannot be dislocated by external manipulation alone without in many instances subjecting the eye to greater pressure than seems wise." He favors the combined operation as a routine procedure. He admits that

the Knapp method seems to be the best intracapsular method at present. It causes less loss of vitreous, and drawn-up pupil does not occur. If the capsule is torn, the lens can be delivered in the ordinary way. It is only by comparing the visual results obtained with the combined method that one can arrive at any conclusion as to the best method. In this manner only can the intracapsular method be properly evaluated.

Campbell (1922) visited the English and European clinics and found that most of the men were doing the forceps method of cataract extraction.

Kalt (1923), in describing his method, recommends the use of atropine, corneal suture and peripheral iridectomy. "Avec la suture on est le maitre de la situation." ("With the suture one is master of the situation.") He has used this method for more than thirty years. He uses a small hook to grasp the iris, and only a small piece is excised. Physostigmine is not used. The corneal suture is removed in four days. He introduces his blunt capsule forceps into the anterior

TABLE 6.—*Kalt's Results*

	In the Capsule	A Large Piece of Capsule Removed	Small Piece Removed	None Removed
Number of cases.....	57	57	67	22
Successful.....	27%	27%	34%	10%
Vision in.....	50% = 0.7 to 1	72% = 0.6 to 1	46% = 0.6 to 1	
Vision in.....	50% = 0.4 to 0.7	28% = 0.4 to 0.6	54% = 0.3 to 0.6	

chamber and grasps a large piece of the capsule, and then tears as much of it away as possible. He has used this method for over thirty years. His results have been very good. He thought it unnecessary to publish them.

He considers that the ideal method is to tear away a large piece of the capsule rather than to perform extraction in toto, to avoid traction on the ciliary body. The necessity for operation for secondary cataract has disappeared in his service. Capsulectomy is the operation of the future.

Weil (1923) published the comparative results between 150 cases of operation by the capsulectomy method of Kalt and 15 cases in which a capsulotomy was done. In the cases in which capsulotomy was done 50 per cent required a second operation; in the cases in which the forceps method was used 17 per cent required a second operation. Weil is favorable to the Kalt method of extraction.

Rochon-Duvigneaud (1924) uses the Kalt forceps to perform a capsulectomy. This is the ideal operation in his opinion.

Paculin (1924) believes that all intracapsular methods are difficult and dangerous and that the results are doubtful.

Kalt (1925) again discussed the principal points of his method. He recommends a peripheral iridectomy and corneal suture. While dislocating the lens, he makes counter-pressure on the upper surface of the globe, the reverse of Török's procedure. The lens is dislocated, or a large piece of capsule is torn away. He gives the results of 466 cases. In 1923 he had already reported 205 cases; in 1925 he reported an additional 261 cases. He concluded his article, "Laisser délibérément dans l'oeil le sac capsulaire, me parait actuellement une énormité." ("Deliberately to allow the capsule to remain in the eye appears to me to be an enormity.")

Jocqs (1925) discussed the advantages and disadvantages of the intracapsular operation. He quoted Finley, who performed fifty operations with the Barraquer technic and had loss of vitreous in 30 per cent, while in seventy-five cases with the Smith method he had loss of vitreous in 12 per cent. He believes that each operation has its indication. The Barraquer method is the choice in immature cases, while the

TABLE 7.—*Additional Data by Kalt Published in 1925*

Successful Cases	Removed in Capsule	Large Piece of Capsule Removed
89%	25%	53%
Vision	84% 0.5 to 1	
Vision	13% 0.3 to 0.4	
Vision	3% 0.2 to 0.05	

Smith method is better in hypermature cases. The one great danger in either case is the loss of vitreous.

Rochon-Duvigneaud (1925) performed some experiments on cadavers and showed that large pieces of capsule can be removed by the Kalt forceps.

Harston (1925) also prefers the capsule forceps method rather than the cystotome.

Sinclair (1925) designed his own type of intracapsular forceps which had a double cross action. He also follows the Kalt method. In thirty-eight cases in which this method was used, twenty-nine cataracts were removed in the capsule. There was loss of vitreous in two cases. The vision in twenty-four cases was 6/9 or better, the average being 6/7. He admits that this is a difficult operation and should not be undertaken until one has had considerable experience in the other methods.

De Saint-Martin (1925) published the results obtained in using the Kalt and Barraquer methods. Although the percentage of complications was greater with the Barraquer method, he prefers it to the Kalt method.

Knapp (1925), in speaking before the Convention of English-speaking ophthalmologists in London, said:

It is stated that the intracapsular operation unduly traumatizes the eye, displaces the pupil and sets in action degenerative changes in the vitreous which result in ultimate damage to the eye; some even claim that the posterior capsule should be retained as it serves as an important support for the vitreous.

He examined and followed up 200 cases, occurring between 1910 and 1919, in which his method was used. Eighty-five patients were examined. In 57, the vision was as good after several years as it was immediately after the operation. As to the vitreous, after the operation it appeared as a membrane. Knapp calls this the hyaloid. It bulged forward and showed many fine brown dots on its surface. Occasionally holes were seen in the hyaloid. The vitreous was very clear and much clearer than after capsulotomy. He explained this as being due to the absence of iridocyclitis when his method was used. He quoted Munoz

TABLE 8.—*Results of De Saint-Martin with Kalt and Barraquer Methods*

	Barraquer	Kalt
Cases	50	50
Vision	50% 1 to 0.8	20% 1 to 0.8
Loss of vitreous	22%	8%
Prolapse of the iris	28%	4%

Urra and Elschnig, who made slit-lamp studies on the vitreous after intracapsular operation. Urra said:

Immediately after operation small infiltrations produced by leucocytes can be seen which are due to slight attacks of cyclitis but after the first week the vitreous is entirely normal. Sometimes the vitreous make a small hernia through the pupillary opening. In this case pigment from the iris is seen on the surface of the hyaloid where it remains.

According to Elschnig:

The vitreous almost always forms a rounded mushroom shape prominence which projects into the anterior chamber seldom covered by an intact vitreous membrane but generally by one that seemed to be riddled with small holes. Even in many cases in which no vitreous entered the anterior chamber free floccules of vitreous could be found as far forward as the posterior surface of the cornea. In all cases of extraction in the capsule, but least in the Barraquer method, the vitreous membrane and the deeper vitreous layers seem to be studded by veils, threads and pigment dots. Only further observations over a period of years can show whether such vitreous conditions are prejudicial to the integrity of the eye.

Glaucoma as a complication occurred in one case six years after operation. In chronic glaucoma, cataracts are easily removed by Knapp's method; no case of detachment of the retina was seen; no case of detached choroid remained; in three cases the hyaloid showed a few

faint opacities, and the pupil was distorted and drawn up, and in two cases striate keratitis persisted. His conclusions are:

> In general on looking over the late results after this method of operation it seems that if the primary results are good and excellent vision is retained, as the cases show after a lapse of from ten to fifteen years. . . .

In his opinion, this emphasizes the assumption that retained capsule and cortex or needling operations cause virteous disturbances. There was no evidence of degeneration of the vitreous which could lead to pathologic changes in the eye.

Braunstein (1925) prefers classic capsulotomy for cataract extraction.

Barker (1925) favors the two-stage operation, and advises removal of the anterior capsule by means of the Kalt forceps. He believes that an iridectomy should precede the extraction.

John Green (1926) adopted the same procedure as Barker. He performs a preliminary iridectomy, and after a few weeks extracts the lens by doing a capsulectomy. In 72 per cent of seventy-six cases in which this was done, vision was 6/12 or better.

Licsko (1926) had a special type of forceps made with blunt teeth. Iridectomy is performed first, and the forceps then grasps the lens capsule, the lens being dislocated while pressure is applied after the Török modification. In 204 cases, 30 per cent were successful. The visual acuity was 5/10 or better in 48 cases.

Kubik (1927), in reporting from Elschnig's clinic at Prague, believes that the Smith operation is too rough and that the Barraquer method is technically poor. The method of Stanculeanu-Török is the best in his opinion; it was used at the Prague clinic during the past year and a half. The main points of the technic used are: retrobulbar anesthesia, a conjunctival suture and a small peripheral iridectomy. Elschnig's modification of Kalt's forceps is used to grasp the capsule. From January, 1926, until March, 1927, 189 operations were performed in this manner. Eighty-six cataracts were extracted in the capsule. In 58 cases, the capsule was torn away. In the early cases, the loss of vitreous was 6 per cent; in the last 144 cases, the loss was only 2 per cent. Prolapse of the iris occurred in 6 cases. Kubik praises this method highly and advocates it for almost all cases except for large lenses in cataracta nigra. Pascheff, in discussing Kubik's paper, said that he uses a conjunctival flap in doing this method. After the extraction, a small peripheral iridectomy is done. Scopolamine is always instilled after the operation. Von Both uses the forceps method at the University Clinic at Pecs. In 84 cases in which the intracapsular method was used, there was postoperative inflammation in only 1.2 per cent, whereas in 175 cases in which capsulotomy was done the per-

centage was 5.1. Blum reported the results of 30 cases performed at Professor Stock's clinic at Tübingen. The forceps method was used. There was slight loss of vitreous in 6 cases.

Parker (1927) gives the comparative results obtained in 300 cases of cataract extraction performed by different methods. He concluded that in selected cases the simple or the Knapp method of extraction may give as good results as the combined method in unselected cases. In the simple operation, secondary cataract is more frequent. He believes that the best results are obtained in the combined operation.

Dunphy (1927) made a survey of 2,560 cataract extractions at the Massachusetts Eye and Ear Infirmary between January, 1915, and January, 1925. The visual acuity in 50 cases in which vitreous was lost

TABLE 9.—*Comparative Results in Cataract Operations Given by Parker*

	Combined	Simple	Knapp
Cases	100	100	100
Vision	70% = 6/12 or better	70% = 6/12 or better	63% = 6/12 or better
Secondary cataract	14	30	3
Loss of vitreous	4	2	6

TABLE 10.—*Comparative Results in Cataract Operations Given by Dunphy*

	Combined	Simple	Intracapsular (Knapp, 436; Barraquer, 5)	Smith
	1,821	298	441	
Loss of vitreous	7.1%	8.67%	18%	19.7%

during the operation was investigated with the following results: good, 20 cases; fair, 11 cases; poor, 9 cases; bad, 10 cases. The average visual acuity was: 16 intracapsular cases, 20/50; 28 combined cases, 20/59. From his studies, he concluded that loss of vitreous has an influence on the visual acuity, and also that loss of vitreous occurred more frequently in the intracapsular cases.

Verhoeff (1927) grasps the lens at its upper margin with forceps. To do this, the lens is tilted forward by applying pressure to the lower part of the lens through the cornea by a squint hook. The lens is removed by traction from above, combined with pressure through the cornea from below. In 80 per cent of eighty cases, the lens was removed successfully in the capsule. In his mind there is no doubt that this method is superior to the Smith or Barraquer procedure. It demands no elaborate apparatus. It surpasses Knapp's, because it gives a stronger hold on the lens, and there is less chance for loss of vitreous.

Knorr (1928) reported the results of 100 operations for the removal of cataract performed in different ways. He believes that the combined operation is the safest of all. He agrees with Verhoeff that immature and hypermature cataracts are especially suitable for the intracapsular forceps method and with Wilder that the preliminary iridectomy is not so safe as some say; he also agrees with Würdeman that the conjunctival suture has increased control over the operation and adds to its safety.

Hörven (1928) had adopted the method that Elschnig uses with the exception that no suture is placed in the superior rectus or conjunctival flap. The pupil is dilated with homatropine. A small peripheral iridectomy is done. A pair of smooth forceps (Elschnig's) is introduced into the anterior chamber, and the capsule is grasped. The lens is then dislocated while pressure is exerted against the cornea with a Daviel spoon or a squint hook. Thirty-four patients were operated on in this manner with successful results in twenty. Fourteen lenses failed

TABLE 11.—*Comparative Results in Cataract Operations Given by Knorr*

	Combined	Simple	Smith	Knapp-Török
	83	10	2	5
Loss of vitreous	3.6%	20%	100%	0
Average vision	20/55	20/35	20/60	20/43

to be delivered in the capsule. The method does not seem to be indicated in intumescent lenses, since in this type Hörven had most of his failures. The vision obtained was from 5/6 to 5/15. He is an admirer of this method because one needs no special apparatus, the technic is simple, and the danger of loss of vitreous is small.

Knapp (1928) described his own method of intracapsular extraction. He uses a blunt Kalt forceps to grasp the capsule at its lower third. After dislocating the lens, he releases the forceps and then expresses the cataract by external pressure. In the Stanculeanu-Török method, the forceps pull the lens from the wound. This operation is indicated in certain cases. The patients should be cooperative, and the vitreous must be in good condition. The method is not good in myopic patients. He reported the results of his studies made in cases in which capsulotomy was performed before 1926.

In his opinion, postoperative glaucoma is one of the most serious and dangerous conditions to treat. He believes that this condition is due to retained cortex and subsequent iridocyclitis. Gifford, in discussing his paper, stated that he prefers the use of the cystotome to any method of intracapsular operation and does not believe that capsule tags cause glaucoma.

Safar (1929) reported the results obtained in fifty cases of intracapsular extraction in which the Elschnig modification of the Stanculeanu-Török method was used. The main features of this method are: akinesia of the lids; control suture in the superior rectus; retrobulbar anesthesia; conjunctival flap with suture; and Hess iridectomy. Elschnig's forceps were used to extract the lens. In forty cases, the cataract was extracted in the capsule; in six cases, the capsule tore, but it was removed. In four cases, the lens was removed by capsulotomy. The visual results were good. Complications were few. Visual results were: 6/5, two cases; 6/6, nineteen cases; 6/8, fourteen cases; 6/12 or better, eleven cases; 6/18 to 6/24, two cases.

Peter in 1923 had already reported the results of slit-lamp studies of the vitreous after cataract operations. Four cases were studied, two by Barraquer, one by Smith and one by the author. From the standpoint of perfect technic, both Barraquer operations were perfect. Both

TABLE 12.—*Comparative Results in Cataract Operations Given by Knapp (1928)*

	Extraction	DeWecker	Discission
Blunt forceps	87	2	4
Toothed forceps	76	3	5
Toothed forceps with cystotomy	29	3	5
Cystotomies	7	0	3
Operation for glaucoma	6	0	0

cases showed tremulous irides and both had marked opacities of the vitreous. One of the cases in which Smith's method was used was far from perfect from external appearances, but conditions in the interior of the eye in both cases were most satisfactory. It was evident that more trauma was applied to the delicate hyaloid membrane by the suction method than by expression by pressure from without. "If this is true in the clever hands of the master of this method, it will be more so in the hands of one who is less skilful and has had little training in the operation. In the discussion of the Barraquer operation at the International Congress of Ophthalmology in Washington, 1922, the opinion was freely expressed that the removal of the lens in its capsule would undoubtedly weaken the wall which held the vitreous in place; as nothing but the hyaloid membrane remained." Regarding the suction method, he believes few will attempt it. The Smith method, on the other hand, or its modifications, he said will be used in selected cases by a limited number of surgeons. As to the dangers of discission, the presence of vitreous in the anterior chamber may jeopardize the integrity of the eye by causing secondary glaucoma or choroidal detachment. These are important questions, and further studies on the after-effects of discission operations on the vitreous will no doubt cause surgeons

to extract cataracts with the least possible injury to the vitreous. This is an important point, and only future investigations and observations will give more light on this question. The presence of the vitreous in the anterior chamber may be more dangerous to the eye than one now believes. If this is so, discission will become more unpopular. It would seem that the hyaloid has some place and function in the eye, and if it is destroyed by operation opacities of the vitreous may follow in later years.

Peter has contributed a more recent article on the intracapsular removal of cataract. The details of his technic follow: Two per cent procaine is injected into the ciliary ganglion and two lid sutures are introduced which remain in place for about five days. A trained assistant controls the lids during the operation. The section ends in a broad conjunctival flap. A narrow complete iridectomy is performed, and the lens is then removed with the Kalt blunt forceps, while slight

TABLE 13.—*Data Given by Kubik on 526 Cases*

Type	Number of Cases	Successful	Vision
Incipient	28	24	6/6 , 421 cases
Immature	216	178	6/36, 22 cases
Mature	200	138	6/60, 24 cases
Hypermature	24	16	
Complicated	20	8	
Cyclitic	23		

pressure is made on the cornea with a squint hook. After the lens is extracted, the conjunctival sutures are tied. If the capsule cannot be grasped by smooth forceps, the Kerrison forceps are used to perform a capsulotomy. In some of these cases there may be epithelial activity some years later. Concerning the objections raised against the intracapsular method, Peter admits that this method requires special training and practice. The operation is not recommended to those who are just beginning their career.

Kubik (1929) again reported the results obtained at Elschnig's clinic. The forceps method of Stanculeanu-Török was used. Operation was performed in 526 cases during a period of seventeen months, from April, 1927, until October, 1928. The technic was practically the same as that reported in 1927.

In the total series there were 109 failures. From this experience the members of the staff at the clinic believe that the younger the patient, the better is the result. In morgagnian cataracts, the capsule is difficult to grasp. They also believe that loss of vitreous is high no matter what operation is used. The ability and skill of the operator are the determining factors. Hernia of the vitreous into the anterior

chamber was often seen, but they believe that this has no serious results. Prolapse of the iris occurred in 2.7 per cent, loss of vitreous in 5.3 per cent and drawn-up pupil in 10 per cent. After the intracapsular operation, the anterior layers of the vitreous show fine, pigmented spots which are not seen in the deeper layers. They may be due to the action of the aqueous. This condition is rarely seen after capsulotomy. It remains for future study to determine whether the action of the aqueous is detrimental to the integrity of the eye. Postoperative glaucoma was seen in six cases, retinal detachment in two cases.

Concerning the intracapsular operation, Kubik believes that this method has many advantages. The necessity for only one operation, the fact that convalescence is shortened and the absence of iritis make it the operation of choice for those who are well trained. This method is especially applicable in incipient, immature, diabetic and high myopic cases.

Kubik compared the results obtained in using this method with the results reported by Barkan when capsulotomy was used. He found that the results were equal, if not superior, to those obtained with capsulotomy. He does not believe that this method of extraction should be attempted by inexperienced or poorly trained surgeons. Special training and preparation are essential.

SUMMARY

The literature on intracapsular cataract operation is partial to one of the three methods already described in this paper. After reading the different opinions, one realizes that there is no unanimity as to the best method. In fact, the intracapsular operation at any time is a questionable procedure to a large number of ophthalmic surgeons. It can be safely said that in America the intracapsular method is not the usual one. The classic operation still remains the operation of election in the hands of most men. In Europe, the intracapsular method appears to be gaining ground more than in America. Before any radical step or innovation in the removal of cataract can be adopted it must produce the best results in the hands of the average ophthalmic surgeon. No surgeon will attempt a new operation with an element of risk and uncertainty and cast aside the method which in his hands has been successful.

As to the Smith operation, it is fast losing ground, especially in Europe. In America, the Smith method had about ten followers, but of late its stalwart defenders are apparently not practicing it with any degree of frequency. At least, few articles have appeared in the literature advocating this method. In Europe, Smith's method has never been popular. A few surgeons tried it, but soon gave it up. In India, the method is still popular; however, there conditions are different than

in America. No surgeon in America is besieged by hundreds of patients requesting immediate relief from cataract. When one considers that the average busy surgeon in America and Europe operates on about fifty patients a year, one can realize why these men hesitate to adopt a radical procedure such as Smith's. In America, the average patient acts with deliberation and caution before submitting to operation.

The chief disadvantages of the Smith method are the frequent losses of vitreous and drawn-up pupil. Its advantages are freedom from iritis and iridocyclitis, the lack of necessity of a second operation and the fact that any type of cataract in any stage of maturity can be removed at any time. At present it appears that its disadvantages are too great. Its dangers will never allow it to become popular among the rank and file of ophthalmic surgeons.

The Barraquer method attracted some attention in America, but more so in Europe. At present about five surgeons in America are using this procedure; in Europe, a larger number are enthusiastic over this method. Its advantages are that any cataract can be removed at any time; no postoperative complications occur, and no second operation is necessary. Its disadvantages are that the instrument is expensive and difficult to operate and liable to go wrong at any time. Moreover, one does not have control over the situation if the patient decides to move his eye. The method has been used extensively by Barraquer, but has attracted little attention in this country; at the present time, it is not popular. However, it is new and only the future can prove whether it will become more popular. It can be regarded as being in the experimental stage. The operation demands special training and experience which cannot be gained on American patients.

The Kalt forceps method or one of its modifications appears to be more popular than any other intracapsular procedure. The operation needs no new or complicated instrument and can be attempted in all cases. Some men in America attempt to remove the lens in its capsule, while Kalt, the originator of the method, is satisfied to tear away a large piece of the capsule. The operation is very popular in Europe, especially in France, Germany and England. It appears to be the leading intracapsular method in America. From a review of the literature it can be seen that this method is the most popular of any intracapsular method employed at this time. However, a few of its objectors say that no method is justified in which a pull is made on the ciliary body, and they claim that capsulotomy is safer. Despite these objections, the method is being used by many leading surgeons both here and in Europe, and it is growing more popular and no doubt will grow more frequent as it becomes perfected.

The forceps method of extraction appears to be a step toward the ideal method. It has all the advantages of the other methods without their disadvantages. It can be used in suitable cases, and as one becomes more experienced its application can be more frequent. The case reports of those who are using this method of extraction show good results, and the postoperative complications are few. There is less danger to the eye, and loss of vitreous is not frequent or large in amount if it occurs at all.

The question of the effect of the hernias of the vitreous into the anterior chamber as raised by Peter is an important one. Only further observations can determine whether these hernias cause opacities of the vitreous or secondary glaucoma. If they do, discission operations will diminish in frequency, and intracapsular operations will have to preserve the continuity of the hyaloid membrane.

Ellet (1930), in reviewing the outstanding points of the International Congress of Ophthalmology held in Amsterdam, September, 1929, said:

> The trend in cataract operation was rather definitely indicated and in the light of this congress one might speak of the "modern cataract operation" as being an extraction in the capsule with a peripheral iridectomy and suture of the conjunctival flap. The Smith operation was not mentioned.

CONCLUSIONS

1. The prophecy of Smith appears to be unsubstantiated.
2. Classic capsulotomy is still the most popular method of cataract extraction among most surgeons.
3. The intracapsular operation is rapidly gaining ground in America and Europe.
4. The Smith method has apparently fallen into disuse.
5. The Barraquer method is attracting little attention from the majority of surgeons here or abroad.
6. The forceps method of cataract extraction is at present the most popular for intracapsular cataract operations.

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News and Notes

EDITED BY DR. JOHN HERBERT WAITE

GENERAL NEWS

The Howe Lectures.—Under the auspices of the Howe Laboratory of Ophthalmology, the 1930 Howe Lectures were given at the Harvard Medical School on December 15 and 17 by Mr. W. Stewart Duke-Elder of London. The first lecture dealt with the physiologic aspects, and the second lecture with the clinical aspects, of recent work on the metabolism of the eye. A complete statement of the lecturer's views is given in Monograph Supplements III and IV of the *British Journal of Ophthalmology.*

The first lecture treated of physicochemical principles found at work in the metabolism of the eye, and particularly of the hydrodynamics of the blood pressure and intra-ocular pressure, of osmotic pressure of the blood colloids, and of changes in pressure attending the contraction of the orbicularis oculi and extra-ocular muscles. Evidence was presented to support the theory that aqueous humour is formed as a dialysate from capillary blood plasma. As compared with blood plasma, the aqueous contains equal proportions of non-ionized constituents, somewhat less of cations, very much less of the colloids and somewhat more of anions in general, all of these proportions explainable on physicochemical grounds. The vitreous body is represented as a hydrophilic, elastic gel, slightly less acid than the aqueous, and differing from the aqueous particularly in that it has a higher colloidal content. Of the total protein in the vitreous of the horse (0.06 Gm. per hundred cubic centimeters as contrasted with 0.02 Gm. in the aqueous and 7.36 Gm. in the blood serum), about one-third is derived from the protein of the blood, while two-thirds is ectodermal in origin and found in neither blood nor aqueous. These ectodermal proteins in the vitreous, mucoprotein and residual protein, appear to have special functions.

The second lecture dealt with the application of fundamental data to the problems of glaucoma, cataract, detachment of the retina and vitreous opacities. Turgescence of the vitreous body, in terms of the iso-electric points of the vitreous proteins and of the concentration of salts, was mentioned in connection with glaucoma. With the maintenance of a constant blood pressure in an experimental animal, using a perfusing fluid driven by an artificial heart through an artificial lung and through the vessels of the head, various effects on intra-ocular pressure are noted following the use of epinephrine histamine, choline, and nicotine. The belief was expressed that the vitreous body may have an autoxidation system similar to that of the lens. Factors relating to detachment of the retina were briefly discussed.

Fourteenth International Ophthalmologic Congress.—At the Fourteenth International Ophthalmological Congress to be held in Madrid, Spain, in 1933, the main theses will be as follows: (1) Detachment of the Retina: Etiology, Medical and Surgical Treatment:

Dr. Arruga, Barcelona, Dr. Ovio, Rome, and Dr. Vogt, Zurich; (2) Tuberculous Iridocyclitis: Pathology and Treatment from Modern Points of View: Dr. E. V. L. Brown, Chicago, Dr. Igersheimer, Frankfurt, and Dr. Lagrange, Jr., Paris.

Conference on Conservation of Sight.—During a recent conference of the National Society for the Prevention of Blindness, held jointly with the National Organization for Public Health Nursing, special discussions were held on the conservation of vision in school children. It was reported that 1,000 school children in New York City had seriously defective vision and had failed to receive the attention that their handicap required. A request for 19 additional sight-saving classes had been made, but the board of education had been unable to meet this request on the ground of retrenchment, creating in the waiting list of 1,000 pupils a feeling of inferiority. There are now 79 sight-saving classes in New York City, accommodating 1,450 pupils, many of them in the elementary grades. There is urgent need for 21 additional classes in the elementary grades, and for 29 classes in the junior and senior high schools. Dr. Jules L. Blumenthal, director of the city bureau of child hygiene, said that the health department in its eleven clinics had examined 16,256 children in 1929, and that 10,905 prescriptions for glasses had been written.

SOCIETY NEWS

Sioux Valley Eye and Ear Academy.—The Academy will meet on Jan. 20, 1931, at the Martin Hotel, Sioux City, Ia. The program will be as follows: (1) "The Paranasal Sinuses as a Focus of Infection"—Dr. C. M. Anderson, Mayo Clinic, Rochester, Minn.; (2) "Retrobulbar Neuritis, Its Etiology and Treatment"—Dr. W. I. Lillie, Mayo Clinic, Rochester, Minn.; (3) Conference: "Duplication of Maxillary Sinus by Vertical Septum"—Dr. E. B. Brooks, Lincoln, Neb.; "Squint"—Dr. James C. Tucker, Beatrice, Neb.; Case Report—Dr. C. K. Shoftstall, and Dr. Tucker, Beatrice, Neb.; Case Report—Dr. J. B. Potts, Omaha, Neb.; "Series of Lateral Sinus Cases"—Dr. S. B. Chase, Fort Dodge, Ia.; "Cataract Extraction in Diabetic Patient"—Dr. C. M. Swab, Omaha, Neb.; "Bronchoscopic Case"—Dr. S. D. Maiden, Council Bluffs, Ia.; Case Reports—Dr. F. W. Dean and Dr. A. M. Dean, Council Bluffs, Ia.; "Right Homonymous Hemianopsia"—Dr. L. N. Grosvenor, Huron, S. Dak.; Case Report—Dr. J. B. Gregg, Sioux Falls, S. Dak.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

THE TOPOGRAPHY OF THE MARGIN OF THE DISK IN MYOPIC AND NONMYOPIC EYES. R. SCHEERER, Arch. f. Ophth. **124:** 53 (April) 1930.

In his histologic studies of eyes with so-called experimental myopia Levinsohn described changes at the margins of the disk which he interpreted as signs of a stretching process. He described the main changes on the temporal side, which consisted of grading off of the scleral edge, formation of loops of optic nerve fibers, retraction of the lamina elastica and of the pigment epithelium and atrophy of the choroid. On the nasal side of the disk, Levinsohn found supertraction of the pigment epithelium and of the lamina elastica over the optic nerve. Scheerer was interested in the frequency of these histologic observations in eyes of children up to the age of 10 which have not yet been exposed to the influence of near work and in eyes of adults who were not myopic. Scheerer comes to the conclusion that these "signs of stretching," as Levinsohn called them, are commonly found in eyes at any age and of any refraction. These signs, therefore, must not be interpreted as the result of exogenous factors that lead to the development of myopia.

P. C. KRONFELD.

THE INTERPRETATION OF A COMPLEX OF CONGENITAL ANOMALIES AS CAUSED BY FIXATION OF FETAL CONDITIONS. P. J. WAARDENBURG, Arch. f. Ophth. **124:** 221 (May) 1930.

Waardenburg describes a family in which every member showed a combination of the following congenital anomalies: ptosis, stiff lids that were shortened vertically and horizontally, aplasia of the semilunar fold, the caruncle and the tarsus, a dislocation of the puncta laterally, a broadening of the interocular region, a peculiar, almost fixed, expression of the face and myopic astigmatism.

A similar complex was described previously by von der Hoeve and Halbertsma. Waardenburg believes that the whole complex has been described several times under different names. Von der Hoeve explained his cases on the basis of a primary elongation of the canaliculi which led to an enlargement of the primordial caruncle. The latter acted as a foreign body and thus caused the formation of an ankyloblepharon.

Waardenburg studied the respective embryonic stages and came to the conclusion that the complex of anomalies described in his paper represents a fixation of fetal conditions.

P. C. KRONFELD.

Color Sense

HEREDITARY COLOR BLINDNESS AND CHANGES IN THE MACULA: A CASE OF TOTAL COLOR BLINDNESS COUPLED WITH RETINITIS PIGMENTOSA. P. J. WAARDENBURG, Klin. Monatsbl. f. Augenh. **84:** 493 (April) 1930.

Color blindness cannot be considered as the final outcome of degeneration in a family via dichromatic anomalies in some earlier generations; according to the author's observations of four cases, in which the histories of three and more generations could be obtained, it is a recessive hereditary symptom. Consanguinity was present. Exact family histories could not be traced in three other cases of this type. In an eighth patient, a girl, aged 6, retinitis pigmentosa and achromatopsia, usually occurring independent of one another, were found. The Wassermann reaction was negative.

Two of the seven cases showed total absence of the yellow hue of the macula, two showed a smaller area, two others showed island-shaped defects, and one presented a normal appearance. The reflex of the fovea had the shape of a comet in both eyes of one patient; the center of the fovea had a dark red hue in three children of the same family. Other symptoms were reduced vision, nyctalopia, photophobia, nystagmus and central scotoma. Partial color blindness was detected in other members of these families. Polydactylism and cleft palate, or similar malformations, were not present. The frequency of hereditary color blindness in Holland is only apparently smaller than that in Switzerland, where older family records are obtainable.

K. L. STOLL.

Conjunctiva

THE RELATION BETWEEN PHLYCTENULAR KERATOCONJUNCTIVITIS AND TUBERCULOSIS. B. G. TOWBIN and W. A. RAWIC-SCERBO, Arch. f. Ophth. **124:** 154 (April) 1930.

In thirty cases of phlyctenular disease of the eye, the authors studied the general physical observations (chest, temperature and blood morphology) and the reactions to parenteral injections of milk (1.5 cc. of milk; the authors do not state what kind of milk was used nor how it was sterilized). As a last step, a Pirquet test was done with the following dilutions of old tuberculin: 1, 3, 10, 30 and 100 per cent. All of the patients were sensitive to tuberculin. A few of them did not respond to 1 per cent dilution, but all of them responded to 3 per cent dilution. The authors did not compare the results that were obtained on patients with phlyctenular disease of the eye with those obtained in a series of subjects of the same age without the disease. No relation between the type of observations of the chest and the eye disease could be noted. The Pirquet test was of the exudative type (formation of blisters or papules without much infiltration or redness) in twenty of the thirty cases. The other ten cases showed the hyperemic infiltrative reaction to the Pirquet test. Focal reactions were observed after the injections of milk in one case, and after the Pirquet test in fourteen cases. In these fourteen cases the

Pirquet test showed an exudative reaction. From these observations the rule could be established that high sensitiveness of the eye to tuberculin (focal reactions) expresses itself in a peculiar skin reaction. In cases in which there were severe inflammatory symptoms of the eye, marked photophobia and tearing, there was an extraordinary sensitiveness to tuberculin, while in other cases in which the phlyctenular process was less acute, the eyes were comparatively anergic toward tuberculin. The sensitiveness of the eye to tuberculin (i. e., the intensity of the inflammatory symptoms) was parallel with the sensitiveness of the entire body to the same virus. The authors explained the phlyctenular process on the basis of the same theory that Kyrle set forth for the development of tuberculids in the skin. Primarily the eyes are sensitized by living tuberculin bacilli which later disappear. The recurrences of the phlyctenular disease represent reactions of the sensitized organs to the tuberculin which is produced by lesions of the chest or intestinal lesions.

P. C. KRONFELD.

THE CLINICAL AND HISTOLOGIC PICTURE OF EPITHELIAL XEROSIS OF THE CONJUNCTIVA. A. KREIKER, Arch. f. Ophth. **124:** 190 (April) 1930.

Most of the cases of xerosis that Kreiker has seen in his clinic (Debreczen, Hungary) were in adults with chronic alcohol intoxication in whom, according to the author, the absorption of the vitamin A was disturbed (chronic gastritis and enteritis). The development of the Bitot spots was studied in excised pieces of conjunctiva. The first stage of epithelial xerosis is characterized by disappearance of the goblet cells and changes of the conjunctival epithelium, which becomes more and more similar to the epidermis. Later the upper rows of cells undergo hyaline degeneration. Below this layer cornification takes place. This layer finally reaches the surface and forms the Bitot spot. The subepithelial tissue shows fewer cells than normally, enlarged lymph spaces and very coarse fibers.

Kreiker concludes from his histologic observations that there is a xerosis without macroscopic symptoms, a stage that he calls prexerosis. The normal epithelium of the conjunctiva is neither cylindric nor flat and stratified, but is a transition epithelium with secretory and protective functions, and as such is related to the epithelium of the uropoietic system.

The xerosis that is caused by trachoma is similar to the epithelial type and is probably due to a local nutritive disturbance.

P. C. KRONFELD.

Congenital Anomalies

A CASE OF CRATER-LIKE HOLE IN THE OPTIC DISC. J. H. DOGGART, Brit. J. Ophth. **14:** 517 (Oct.) 1930.

A woman, aged 31, showed a large inferior crescent in the right eye, with heaped-up pigment along most of its lower border. An oval, grayish-blue hole was situated in the inferior temporal quadrant of the optic disk, lying with its long axis in the direction of the long axis of

the disk. The depth of the hole was about 9 diopters. No vessel was visible, although two small ones could be seen in close relation to its margin. The macular region was normal. There was a low degree of compound myopic astigmatism in each eye, the correction of which gave a visual acuity of 6/9 in the right eye and 6/6 in the left eye. The field of vision showed an enlargement of the blind spot, a large relative scotoma supertemporally and a wide area of relative defect for the smallest objects used. The author attributes these defects to the inferior lesion rather than to the hole in the disk. The fundus of the left eye was normal.

According to the author, there are about forty-two cases of this congenital anomaly in the literature, two thirds of them occurring in women.

W. ZENTMAYER.

TERATOGENIC OCULAR ANOMALY. CONTRARAS JIMENEZ, Arch. de oftal., hispano-am. **30:** 144 (March) 1930.

The author reports a case with illustrations, in which, on the left side, the skin of the brow passed over the eye without any differentiation of the lid, and the skin moved with the rudimentary eye, giving the impression of the nonexistence of a cornea, owing to a differentiation of the ectoderm and mesoderm, the former forming only skin in lieu of the cornea. On the right side, in the site of the orbit, there were two osseous rims forming a canal, without any sign of an eye, which was continued outward into a fontanel, with the initial formation of an encephalocele. The anterior fontanel was normal. The remainder of the body showed a normal development.

C. E. FINLAY.

Cornea and Sclera

MARGINAL DEGENERATION OF THE CORNEA. J. H. DOGGART, Brit. J. Ophth. **14:** 510 (Oct.) 1930.

The author's case was seen in the service of Parsons at Moorfields. A man, aged 44, was first seen in 1907, with a mild conjunctivitis of the lower palpebral portion of each conjunctiva.

In 1916, when 30 years of age, a vascularized peripheral gutter was noted in the upper portion of the left cornea. By 1928, the vision was 6/60, and in 1930 it was limited to finger movements, but with + 2 diopters spherical, —12 cylinder, axis 90 degrees, the vision equaled 6/12 mostly. At the time this article was written there was a crescentic, vascularized ectasia situated at the upper part of the periphery, measuring about 3 mm. across the widest part. Centrally the ectasia was bounded by a distinct wavy white line at which the vessels stopped short. The biomicroscope showed bulging of the cornea, which was only one fourth of its normal thickness. The endothelium was not visible in the middle, but its amorphous remains appeared in the lateral portions of the ectatic zone. Immediately below the two ends of the white line, for a distance of 1 mm., the corneal stroma showed abundant small glistening crystals and ill defined grayish opacities. At the lower limbus, in the region of 7 to 5 o'clock, there were an abnormal accentuation of the scleral

prongs, which composed the palisade zone; an encroachment here and there of conjunctival vessels on the cornea for a distance of 1 mm., and a number of scattered grayish dots of opacity in the substantia propria, but as yet no demonstrable thinning of the cornea. These phenomena presumably denote the beginning of that process the stages of which are evident in the upper periphery.

In the right cornea, which appeared normal to the naked eye, inspection revealed the same early changes without appreciable thinning at the 10 to 2 o'clock and the 7 to 5 o'clock regions of its periphery. A furrow will almost certainly appear at some future time.

The literature is reviewed and the clinical, pathologic and therapeutic aspects are dealt with.

W. ZENTMAYER.

DISEASES OF THE CORNEA IN ACQUIRED SYPHILIS JUAN PALLARÉS LLUESMA, Arch. de oftal. hispano-am. **30:** 137 (March) 1930.

After reference is made to the extreme rarity of corneal diseases in acquired syphilis as compared to their frequency in inherited syphilis, especially as regards parenchymatous keratitis, notwithstanding the practical identity of the two processes, the author divides the cases of parenchymatous keratitis in acquired syphilis into four groups: (1) cases in which infection has occurred during lactation (generally unsuspected), with a negative family history and a negative Wassermann reaction in the mother and younger brothers; (2) cases in patients who have both inherited and acquired syphilis; (3) cases in eyes originally the seat of a primary infection, and (4) cases in patients, with healthy parents, who have acquired syphilis in the usual manner and in whom parenchymatous keratitis has later developed. The last group is the most numerous and occurs most frequently in the tertiary stage and rarely in the secondary; in 50 per cent of the cases only one eye is affected and there is a slight tendency to vascularization.

As regards other corneal diseases, the author mentions: Mauthner's keratitis punctata, Hoch's punctiform interstitial keratitis. Alexander's keratitis punctata (which he differentiates from Mauthner's) and Bayer's pustuliform keratitis and gummatous keratitis.

The author next reports a case of superficial ulcer of the cornea in a patient with an old syphilitic process, which developed into parenchymatous keratitis, accompanied at first by plastic iritis.

C. E. FINLAY.

TREATMENT OF SERPIGINOUS ULCER OF THE CORNEA BY MEANS OF IONTOPHORESIS WITH ETHYL HYDROCUPREIN HYDROCHLORIDE. RICARDO ARRUGA, Arch. de oftal. hispano-am. **30:** 327 (June) 1930.

After general considerations on iontophoresis and the occurrence of unsatisfactory results, the author describes iontophoresis as employed at Clausen's Clinic at Halle, where a galvanic current of 2 milliamperes is applied for from two to four minutes through cotton soaked with a 1:100 solution (anode) of ethyl hydrocuprein hydrochloride directly to the corneal ulcer, the cathode being applied to the cheek.

The author reports twenty-one cases, ten with superficial corneal ulcers to which a single application of a 2 milliampere current was made for two minutes, with the following visual results: Five cases, 5/5; three cases, 5/18; two cases, from 5/12 to 5/18. The remaining eleven cases were of severe corneal ulcer with infiltration of the deeper layers of the cornea, the duration of the application varying between two and four minutes. In five cases only a single application was necessary, in three two were required and in the other three a third application was made. The visual results obtained were: Three cases, 5/8; four cases, 5/18; three cases, 5/30, and one case, 1/50. In several cases a paracentesis of the anterior chamber was necessary.

The advantage of the method consists principally in the thinness of the scar as compared with that following corneal cauterization.

Iontophoresis is also applicable with anions of iodine and chlorine for clearing up corneal opacities, in the treatment for different types of keratitis with cations of zinc and recently with gold chloride for tattooing the cornea.

C. E. FINLAY.

PREXEROSIS AND XEROSIS CORNEAE IN ADULTS. A. PILLAT, Arch. f. Ophth. **124:** 486 (July) 1930.

Xerosis corneae is a condition of dulness and dryness of the epithelium, which is the first symptom of beginning keratomalacia in children. This condition is almost unknown in adults. Pillat (Peiping, China) had the opportunity to study typical cases of keratomalacia in adults (ARCH. OPHTH. **2:** 256 and 399 [Sept.-Oct.] 1929). The present paper deals with another clinical picture caused by lack of vitamin A in adults, namely, the xerosis and prexerosis corneae. Both diseases may last several months without leading to keratomalacia, and they heal promptly if the proper food is given. Both diseases are usually combined with hemeralopia and xerosis conjunctivae, but they can occur without these symptoms. A peculiar feature of the xerosis and prexerosis corneae is a brownish pigmentation of the conjunctiva which starts out from the semilunar fold and extends into both fornices, the conjunctiva sclerae and even into the cornea.

Prexerosis is a condition of diffuse dulness and reduced sensitiveness of the corneal epithelium. A corneal smear reveals the same germs that are found in keratomalacia. Striking is the rapid drying of the cornea, which can take place within a few seconds. Xerosis corneae is characterized by grayish deposits on the surface of the cornea, either in its center or near the limbus. The prognosis of both diseases is good; both heal without leaving scars. The treatment consists of the use of cod liver oil and the proper food, with large quantities of vitamin A.

P. C. KRONFELD.

A FAMILY TREE OF BLUE SCLEROTICS AND THE THEORY OF ITS TRANSMISSION. H. KUNII, Ztschr. f. Augenh. **71:** 328 (July) 1930.

An interesting report is made of a family of forty-five persons who were examined for blue sclerotics, and a résumé of the literature on the subject is added. From a survey of both, Kunii concludes that blue

sclerotics is a dominant characteristic that is transmitted by either male or female and is present in some form in half of the relatives. The complications accompanying the ocular manifestation are osseous fragilis, deafness, abnormalities of the long bones, small stature and dental disturbances.

A. M. YUDKIN.

Experimental Pathology

THE RELATION BETWEEN HYPERGLYCEMIA AND GLYCOSURIA IN EXPERIMENTAL DIABETES AND IN CLINICAL CASES WITH OCULAR CHANGES. N. COLLEVATI, Saggi di oftal. **5:** 195, 1930.

The author's experimental work, previously reviewed, showed that certain animals showed glycosuria with normal blood sugar, while in others with hyperglycemia the urine remained normal. He reviews cases from the literature with hyperglycemia and ocular changes characteristic of diabetes, but without glycosuria. He has collected fourteen cases from the di Marzio Clinic showing these conditions, the ocular lesions comprising retinal hemorrhages, cataract, retrobulbar neuritis and iridochoroiditis. The complicated conditions of metabolism and renal permeability that may explain these observations are discussed, and the importance of simultaneous study of sugar in the blood and urine for the diagnosis and prognosis of patients with ocular lesions is emphasized.

S. R. GIFFORD.

EXPERIMENTAL STUDY OF QUININE AMBLYOPIA. F. SCARDAPANE, Saggi di oftal. **5:** 240, 1930.

In line with his previous clinical report on quinine amblyopia, the author takes up the question of its pathogenesis. He discusses previous contributions, which are divided in their conclusions, some observers believing that the drug acts on the vessels, others that it affects the nervous elements directly. Twenty cases were found in the literature showing ophthalmoscopically no changes in the fundus, and a study of other cases shows that contraction of the vessels is by no means a constant observation. Pharmacologically, quinine produces vasodilatation by paralysis of the smooth muscle.

Six dogs were given toxic doses of quinine hydrochloride subcutaneously. All showed symptoms of blindness after from two to ten hours, with the pupils dilated and unresponsive to light. This condition began to clear up in twenty-four hours, and the eyes were apparently normal in from three to five days, except when a fatal dose was given. Frequent ophthalmoscopic examinations showed vasoconstriction of the retinal vessels in only two animals, in which the toxic symptoms were especially pronounced. In one animal an actual hyperemia of the disk with dilatation of the veins was observed, while in the others the fundus remained practically normal. Thus, vasoconstriction would not seem to be an essential part of the picture. The eyes were examined post mortem after various intervals, special technic for staining the nervous elements being carried out. Changes could be seen in the ganglion cells after ten hours, going on to complete degeneration and chromatol-

ysis of many cells after seven days. Clumping of the neurofibrils at their entrance to the cells was observed, which the author believes is especially important. No changes in the myelin sheaths of the nerve tracts were seen nor did the nerve fibers of the intracranial portion of the nerve and tract or the cortical visual cells show any demonstrable lesions. The nerve fiber layer of the retina and the optic disks showed fusiform thickenings and other degenerative changes. The author concludes that the primary toxic effect of quinine is on the ganglion cells and nerve fiber layer of the retina and the intra-orbital portion of the nerve, and that the amaurosis is independent of changes in the vessels.

S. R. GIFFORD.

EXPERIMENTAL HYPERAZOTEMIA AND OCULAR CHANGES. U. COLLEVATI, Saggi di oftal. **5:** 467, 1930.

The author performed unilateral nephrectomy on two dogs, one of which was fed large doses of urea, while three dogs on which operations were not performed received urea, ammonium carbonate and glycine in large doses. In all cases hyperazotemia was produced, which produced no toxic symptoms until the renal elimination became insufficient. The eyes showed marked degeneration of the ciliary processes, vacuolar changes in the lens, apparently due to increase in the osmotic pressure of the blood, and edema of the nerve head, with congestion of the veins, going on to slight elevation of the disk in some animals. This was explained as part of a general edema due to some toxic substance in the blood stream. The urea in the aqueous was increased, but not to the height reached in the blood.

S. R. GIFFORD.

General Diseases

RARE FORMS OF HEREDITARY SYPHILIS AFFECTING THE EYE ALONE. A SANTONASTASO, Ann. di ottal. e clin. med. **58:** 117 (Feb.) 1930.

Two children in the same family, aged 2 and 5, were observed by the author, both showing blepharospasm, nystagmus, sluggish pupillary reactions, hyperopic astigmatism and pigmentary degeneration of the retina. The Wassermann reaction was positive in each case, but there were no other signs of syphilis. Cases in the literature presenting similar signs are reviewed. The author ascribes the nystagmus and blepharospasm to a cerebral lesion, and the retinal changes to a syphilitic chorioretinitis. He believes that even the refractive error may be the result of faulty development of the orbit as the result of syphilis. The combination of ocular symptoms was enough in these cases strongly to suggest hereditary syphilis, the presence of which was confirmed by the Wassermann reaction.

S. R. GIFFORD.

A CASE OF ARACHNODACTYLISM WITH ESPECIAL CONSIDERATION OF THE OCULAR SYMPTOMS. F. THADEN, Arch. f. Auguenh. **100-101:** 278, 1929.

In 1912, Archard gave the name arachnodactylism to a disease entity that consists of the relations of the total length of the body to the length and degree of development of the extremities. The arms and

legs, although long, are extremely thin and underdeveloped. Most of the cases show other bony malformations, as dolichocephalism.

Of the twenty-three cases reported in the literature, twelve showed pathologic conditions of the eyes. The most common of these was a luxation or a subluxation of the lens with resulting iridodonesis and deep anterior chamber. Frequently the pupil was exceedingly small and failed to dilate with atropine. In a few cases there was megalocornea. The author describes a case with ocular symptoms. The cornea was definitely enlarged, but there were no other signs of hydrophthalmos. He explains the luxation of the lens on purely mechanical grounds: the cornea being too big, the stretching of the zonular fibers results in their rupture. The cause of this disease is not definitely known, but it is probably congenital.

F. H. Adler.

Glaucoma

Buphthalmos with Facial Naevus and Allied Conditions. A. J. Ballantyne, Brit. J. Ophth. **14:** 481 (Oct.) 1930.

The author reports a case of buphthalmos of the left eye in a male child aged 3 weeks, with a port wine staining of the skin occupying the left side of the face, mapping out fairly exactly the area of distribution of the first and second divisions of the fifth nerve. At the age of 5 weeks an Elliot trephining was performed. The cornea cleared, and two weeks after operation the tension was 16 mm. of mercury (Schiötz).

The patient is probably the youngest on record. The article contains a survey of the literature of cases of nevus associated with buphthalmos, simple glaucoma, secondary glaucoma, pseudoglaucoma, cerebral disease and buphthalmos with neurofibroma. This is followed by a discussion of the various theories that have been advanced to explain these associated conditions. The point of practical importance which emerges from a consideration of these cases, and to which attention has been directed by several authors, is that the presence of a cutaneous nevus, with or without buphthalmos or glaucoma, may give a valuable clue to the nature of a coexistent intracranial lesion.

W. Zentmayer.

Unusual Complication in Regular Enucleation. H. G. A. Gjessing, Norsk mag. f. lægevidensk. **91:** 844 (Aug.) 1930.

In Gjessing's case of advanced glaucoma, with excellent results after antiglaucomatous iridencleises with meridional iridotomy according to Holth in the better, right eye six years earlier, enucleation of the left eye under local anesthesia according to Seidel was followed by temporary complete amaurosis and continued defect in the field of vision. As the anterior chamber was half filled with blood and profuse hemorrhage was feared, twice the usual amount of solution of epinephrine hydrochloride was added to the anesthetic, i. e., 2 drops per cubic centimeter, or 10 drops, half of the maximal dose for subcutaneous application (Poulsson). The damage to the right eye is believed due to the effect of the epinephrine on the already weakened eye.

[J. A. M. A.]

Hygiene, Sociology, Education and History

PSYCHOVISUAL REQUIREMENTS OF AUTOMOBILE DRIVERS. MENACHO, Arch. de oftal. hispano-am. **30:** 310 (June) 1930.

The author analyzes in great detail ocular and psychic requirements of automobile drivers under modern conditions of traffic in large cities. He concludes that: (1) no one should be given a license to drive an automobile without first passing a medical examination as regards his visual requirements; (2) in computing the normal vision in both eyes as 2, only those who have a vision of 1, providing the defective eye has a vision of not less than 0.2, should be admitted; in calculating vision, candidates requiring minus glasses over 3 diopters or plus glasses over 2.50 should be excluded; (3) the following classes of lesions of the eye demand exclusion: persons with only one eye; hemeralopes; persons whose visual fields in one or both eyes do not reach 70 degrees in a temporal direction; persons without binocular vision and persons affected with severe chronic conjunctival disease (trachoma, follicular conjunctivitis or spring catarrh) or lacrimation; (4) when the vision of an automobile driver falls below the aforementioned limits, his license should be withdrawn.

C. E. FINLAY.

Injuries

THE NON-MAGNETISABLE METALLIC FOREIGN BODIES OF THE CORNEA, WITH THE REPORT OF A CASE. B. W. RYCROFT, Brit. J. Ophth. **14:** 501 (Oct.) 1930

After considering the mode of entrance, characteristic appearances, sequelae and the methods of removal of various nonmagnetic foreign bodies, the author reports an instance of solder splashed into the eyes. Both corneas were stippled by a multitude of fine, glistening, metallic particles, evenly distributed and more marked in the left eye. These were situated on the corneal epithelium and in the superficial layers of the substantia propria. Their removal was attempted by frequent douches with a 4 per cent solution of cocaine, which was allowed to dry. When the epithelium was uniformly opaque, it was entirely removed with a fine discission needle. Few of the foreign bodies came away, indicating a marked cohesion between the cornea and the metal.

W. ZENTMAYER.

Lacrimal Apparatus

CLINICAL AND EXPERIMENTAL INVESTIGATIONS ON THE LYSOZYME CONTENT IN THE TEARS AND THE CONJUNCTIVAL SECRETION. C. HALLAUR, Arch. f. Augenh. **103:** 199 (June) 1930.

In 120 clinical cases the lysozyme content of the tears was estimated: (1) in clinically normal conjunctivae and (2) in chronic and acute inflammation of the conjunctiva and cornea. It was diminished only in acute inflammatory conditions of the anterior segment. The amount of lysozyme in the tears depended on the activity of the lacrimal gland.

Atropine diminishes the secretion of tears and leads to an increase in the lysozyme content, while pilocarpine increases the secretion and

leads to a fall in the amount of lysozyme. The significance of this substance as a protection against bacteria is discussed, and its therapeutic possibilities are suggested.

F. H. ADLER.

Lens

THE MANAGEMENT AND TREATMENT OF INCIPIENT CATARACT. L. VERNON CARGILL, Brit. M. J. 2: 419 (Sept. 13) 1930.

After an introduction in which the author repeats the generally accepted objection to the too free use of the term cataract in the lenticular opacities which remain incipient and do not go on to maturity, he advises, in the early stages, careful refraction, dark glasses and proper illumination, and later the use of hand magnifiers, reading screens and telescopic magnifiers. The pathology of cataract is then taken up, the researches on the permeability of the lens capsule, the evidences of defective metabolism and the various biochemical changes that have been observed being described. He concludes with the statement that these extremely complex physicochemical processes will probably be solved, but that their prevention is quite another problem.

Local medical treatment is then described; although its efficiency is questionable, its use may be desirable to comfort certain patients and prevent their recourse to unscrupulous quacks. A thorough physical examination may reveal general disturbances of health, the correction of which may give indirect benefit. Endocrine deficiency and hypothyroidism are particularly important. Finally, the greater importance of the correction of chronic toxemia and a search for infective foci are stressed. These procedures will tend to improve the general health and promote the success of a future operation.

A. KNAPP.

FREQUENCY AND SHAPE OF THE ANTERIOR AXIAL "NAHTPUNKTIERUNG" AND THE ANTERIOR AXIAL EMBRYONIC CATARACT. O. MÜLLER, Arch. f. Ophth. 124: 444 (July) 1930.

The anterior axial "Nahtpunktierung" was described by Vogt in 1922, and consists of very fine white dots which lie along the anterior axial suture system very near the lens capsule. Müller found this slit-lamp picture in 22 of 127 persons. It is a senile change of the lens which becomes more frequent with increasing age without influencing the visual acuity. It can be mistaken for a beginning radial cataract, but the absence of water clefts always speaks against beginning cataract.

The anterior axial embryonic cataract is a well known type of congenital cataract and is found in from 20 to 27 per cent of Vogt's clinical material. This type of cataract seems to be embryologically the oldest one, because it affects almost the central part of the lens. It does not influence the visual acuity.

P. C. KRONFELD.

Lids

PRIMARY SYPHILIS OF THE EYELID. M. DIACICOV, Cluj. med. 11: 79 (Feb.) 1930.

After reporting four histories, the author emphasizes the possibility of always securing the diagnosis of primary syphilis of the eyelid by the evidence of spirochetes and the presence of enlargement of the

ganglions. Such extragenital locations of the primary disease are now more frequently diagnosed because diagnostic means have improved. The most frequent seat of the primary disease of the eyelid is the margin of the lid. Subjective manifestations are slight. Adenopathy is marked and constant. In such cases the patients react well to antisyphilitic treatment.

N. BLATT.

Ocular Muscles

AN OCCLUDER FOR SQUINT. A. RUGG-GUNN, Brit. J. Ophth. **14:** 520 (Oct.) 1930.

The author considers that for various reasons stated nearly all occluders reveal in practice some defect which invalidates their use. He does not believe the principle of complete occlusion, hitherto generally observed, to be necessary or even desirable. The occluder designed consists of two parts, a "half lens" Chavasse glass which covers rather more than the nasal half of the spectacle lens, behind which it is worn, and a rubber projection, which can be trimmed where necessary to fit into the inner aspect of the orbit. When worn the occluder is almost invisible. It should be worn continuously over the better seeing eye. Chavasse glass has one surface plain and the other mottled, the effect being to permit a perfectly clear view of the eye while at the same time vision is reduced to 6/60 or less. Central vision with the better eye is still possible, but it is possible only in the position of outward rotation, that is, relaxed convergence. It emphasizes the relative equality of peripheral vision in the two eyes and encourages a position of the visual axis in which images fall on relatively corresponding points, and by relaxing excessive convergence it may secondarily relieve accommodated spasm.

W. ZENTMAYER.

Orbit, Eyeball and Accessory Sinuses

INTERMITTENT EXOPHTHALMOS AND ITS OPERATIVE TREATMENT A. F. RUMJANZEWA, Ztschr. f. Augenh. **71:** 248 (June) 1930.

By adopting the operative procedure advocated by Golowin in 1897 for occluding the superior ophthalmic vein in pulsating exophthalmos, the author was able to arrest the recurring exophthalmos which he found in a female patient. He made an incision in the skin of the brow about 3 mm. below the tendon of the trochlearis on the inner aspect of the upper lid. The tarso-orbital fossa was exposed, and the superior ophthalmic vein was found behind it. The vein was traumatized and occluded by a suture which was subsequently removed. A perfect result was procured by this procedure.

A. M. YUDKIN.

Refraction and Accommodation

THE REFRACTION CURVE. E. TRON, Arch. f. Ophth. **124:** 544 (July) 1930.

The theory of Steiger concerning the genesis of the spherical refractions is based on three premises, namely: (1) all of the optical elements

of the eye vary according to the normal variation curve, (2) the combination of the optical elements of the eye takes place according to the law of chance and (3) the result of this combination, namely, the refraction of the eye, varies also according to the known variation curve. At the present time the first premise only can be considered as fulfilled. No definite statements can be made about the other two until the refractions of a sufficiently large number of atropinized eyes can be made the basis of a new refraction curve. The author apparently overlooked the refraction curve which, based on a material of about 10,000 atropinized eyes, was recently published (*Transactions of the International Ophthalmological Congress,* Amsterdam, 1929) by E. V. L. Brown and P. C. Kronfeld.

P. C. KRONFELD.

Retina and Optic Nerve

FREQUENCY OF LEBER'S DISEASE AMONG FEMALES. L. H. BECKERT, Arch. f. Augenh. **100-101:** 285, 1929.

The author presents a review of collected cases from which he draws the conclusion that in the majority of these one can say only that there is an inclination to inheritance. This agrees with the observations of Nettleship.

F. H. ADLER.

PATHOGENIC ANATOMY OF RETINITIS CIRCINATA. R. SEEFELDER, Arch. f. Augenh. **100-101:** 334, 1929.

Histologic and histochemical studies show that in the majority of cases the changes in the eyes consist of a heaping up of fatty granules in the region of the inner and outer nuclear and granular layers. The question as to the origin of these changes is discussed.

F. H. ADLER.

SIGNIFICANCE OF ARTERIOSCLEROSIS ON THE RETINA, CHOROID AND OPTIC NERVE IN THE PATHOGENESIS OF RETINITIS ALBUMINURICA. WERNER KYRIELEIS, Arch. f. Augenh. **103:** 161 (June) 1930.

A general review of the literature reveals the fact that retinal changes occur for the most part in renal disease when the vascular system is chiefly affected; in interstitial nephritis, therefore, the retinal changes occur only when damage to the blood vessels has occurred. Since the clinical expression of vascular disease is hyperpiesis, it is natural to regard this as the starting point for the retinal changes, and so in the ophthalmologic literature one finds attention being drawn primarily to a study of increased vascular pressure.

With the appearance of chemical methods of investigation, interest swung largely to their relationship with the appearance of retinal changes. But since it was shown that there was no clearcut and constant relationship between the two, interest has again returned to a study of diseases of the vascular system. The present article is largely a theoretical consideration of these changes in the light of the recent theories of Ricker concerning hypertension. The author studied six

cases of so-called contracted kidney with arteriosclerosis and found arteriosclerosis of the inner tunics and optic nerves in all. He does not feel, however, that the arteriosclerosis is sufficiently widespread to regard it as the primary etiology and he could find no relationship of the degree of retinal change with the degree of sclerosis. The arteriosclerosis is dependent on a disturbance of the circulation, which in turn is based on an increased blood content of the peripheral vascular paths.

F. H. ADLER.

PAPILLEDEMA IN EXPERIMENTUM CRUCIS HOMINIS. CARL BEHR, Ztschr. f. Augenh. **71**: 275 (July) 1930.

In order to prove his theory—Rückstauungstheorie—of papilledema of the optic nerve, Behr offers several observations which he made on experimental material—animal and human—and a case reported by Mariotti. The author shows that there is a circulation in the optic nerve that is produced by parenchymatous secretion in the nerve tissue. The mission of this fluid is to regulate the metabolism of the nerve tissue. It flows centripetally from the disk through the cranial portion of the optic nerve into the third ventricle. It confines itself to the intrapial spaces of the nerve tissue and is not found in the interstitial spaces. The parenchymatous flow is associated with that of the neuroglial system. With this interpretation of his experimental work, Behr concludes that papilledema of the optic nerve is produced by an increase of parenchymatous secretion in the nerve fibers, and this in turn occludes the circulation to and from the retina, giving the picture which is observed in the fundus.

A. M. YUDKIN.

A LOCALIZING OPHTHALMOSCOPE FOR THE GONIN OPERATIVE PROCEDURE IN REATTACHMENT OF THE RETINA. KARL SAFAR, Ztschr. f. Augenh. **71**: 307 (July) 1930.

Safar describes an instrument which he uses successfully in performing the Gonin operation for reattachment of the retina. It consists of a Gullstrand electric hand ophthalmoscope fixed on one end of a long square rod carrier, with a removable cautery needle on the other end; between these two are placed a convex lens for producing a negative inverted image of the fundus at a circular thread localizer for fixing the area to be treated. The pupil is widely dilated with a mydriatic. The area of the detachment is determined with the instrument. Then the cautery is adjusted so that it is exactly in the same position as the observed detachment. The operator then gages the area for cauterization through the ophthalmoscope. The needle is thrust in the sclera and, if it corresponds to the observed tear in the retina, the current is turned on.

A. M. YUDKIN.

Trachoma

THE CONTROL OF TRACHOMA. N. BISHOP HARMAN, Brit. M. J. **2**: 457 (Sept. 20) 1930.

At present trachoma is found in Egypt, China, India, Italy, Ireland, Poland and Russia. It is common among the North American Indians,

and occurs in isolated parts of the United States, but it is extinct in England.

The author takes up in turn the clinical conditions of trachoma, its etiology, and particularly the adjuvant causes such as low standard of living with disregard of sanitary rules. He mentions the former frequency of trachoma in the London Poor Law schools, its eradication by the introduction of isolation schools for pupils with ophthalmia, and finally describes the experience gained in the war.

The author concludes with the statements: that (1) trachoma can be controlled, and (2) that the control of trachoma is a practical proposition. This control depends on whether trachoma is endemic in the particular country, or the country is free from trachoma. In the first case, the bad social conditions must be corrected. Discovery of the disease demands treatment, such as isolation, trachoma schools, local dispensaries and traveling hospitals. In countries in which trachoma is rare, exclusion of immigrants is the proper remedy. The best line of attack always remains a thorough and efficient school service.

A. KNAPP.

THE PROVACZEK-HALBERSTÄDTER INCLUSION BODIES AND THEIR CLINICAL SIGNIFICANCE. T. TABORISKY, Arch. f. Ophth. **124:** 455 (July) 1930.

The author dealt with trachoma in Russia and Palestine for twenty years. He always paid attention to the observations in the smears taken from the conjunctiva. He formulates his opinion as follows: He believes that he is entitled to make the statement that there is no trachoma without inclusion bodies. He found these bodies in every typical case of trachoma that he could observe from the very beginning of the disease. Typical, nontrachomatous diseases of the conjunctiva never showed inclusion bodies. The few cases of conjunctivitis in which inclusion bodies were found, which turned out to be "not trachomatous," resembled trachoma as papillary hypertrophy, diffuse infiltration and follicles were present for a short period. The author's explanation is that these cases are caused by a nontoxic variety of the inclusion bodies which probably come from the urogenital tract.

The inclusion bodies appear with the beginning of the disease, become larger and more frequent with the progression, remain in the epithelium in spite of the treatment and disappear when the clinical picture shows signs of improvement. The epithelium of the conjunctiva tarsi is the most sensitive to the inclusion bodies while the conjunctiva sclera, the limbus and the cornea are more resistant. The author believes that the clinical picture of follicles plus diffuse infiltration does not justify the diagnosis of trachoma unless confirmed by the presence of inclusion bodies in the smear.

The inclusion body blennorrhea of the new-born infant is a disease similar to trachoma and is caused by a genital variety of the inclusion bodies. The scar formation that is sometimes found in these cases is usually the result of a pseudomembranous inflammation.

In Palestine the author observed several cases of chronic blennorrhea in which gonococci and inclusion bodies were found. Similar cases were

reported by Meyerhof in Egypt. In these cases the gonococcus remains in the conjunctiva much longer than usual, because the hypertrophy which is caused by the inclusion bodies, offers more favorable conditions for the development of the gonococcus.

P. C. KRONFELD.

THE CYTOLOGY OF THE CONJUNCTIVA IN TRACHOMA AND THE SIGNIFICANCE OF ITS PATHOGENESIS. P. P. DWIJKOFF and E. F. LEWKOEWA, Ztschr. f. Augenh. **71**: 312 (July) 1930.

From a study of several hundred cases of inflammation of the palpebral conjunctiva, Dwijkoff and Lewkoewa were able to demonstrate three distinct stages in the progress of the cases which they labeled trachoma. In the first stage of this disturbance the tissue was characterized by cellular elements of the lymphatic type. Intermingled with this inflammatory texture was found a cell which the authors considered a lymphoblast. It was found rather sparingly in the sections examined. Monocytes and plasma cells were frequently identified.

The second stage was characterized by an increase of the cellular elements in which the lymphoblasts and plasma cells increased in number and the monocytes remained about the same. All sizes of lymphoblasts were noted. Many of these cells showed mitosis and karyokinesis. This lymphoblastic transformation seemed to be constant in all the cases of trachoma which the authors examined. The plasma cells and the monocytes presented degenerative changes.

In the third stage the cellular elements diminished and the lymphoblasts and plasma cells were almost extinct; only lymphocytes seemed to be present. With this picture before them, the authors review the opinions of several other investigators who studied similar tissue. Their observation of the cellular structure is the same, but they cannot subscribe to the interpretations of other investigators. The work of Pascheff on conjunctival tissue and its activity in trachoma and other diseases is used as a background for their assumption that the process which they found in trachoma is produced by some inherent property of the lid conjunctiva which makes it function as a lymphopoietic organ. They believe that the lymphoblasts are produced in the conjunctiva and play an important rôle in the hyperplasia of the tissue, whereas the plasma cells are secondary and originate from the lymphocytes. This picture is not found in any other conjunctival inflammation. The authors avoid the question of etiology in this report.

A. M. YUDKIN.

Tumors

A CASE OF RING SARCOMA OF THE IRIS. D. R. ADAMS, Brit. J. Ophth. **14**: 448 (Sept.) 1930.

The case was seen in a man aged 44. The disease was in the stage of secondary glaucoma. The gray iris presented two striking, irregular, dark brown pigmentations forming two bands at 11 o'clock and extending around the iris to a larger patch at 5 o'clock. Fine pigment was seen on the posterior surface of the cornea.

Macroscopically, a fine ring of dark pigment could be seen surrounding the anterior chamber in the region of the angle and coming forward on the lower part of the cornea. The iris was thickened. The disk was cupped, and the retinal vessels were engorged.

Microscopically, the growth invaded the iris, the adjacent sclera and the anterior part of the ciliary body. Every section showed involvement of the angle on both sides, indicating that the growth had a ring distribution. The cells were chiefly small spindle cells, with relatively large nuclei. The pigment was in excess of the actual growth and formed large extracellular deposits; fine intracellular deposits could also be seen.

The special interest lies in the fact that it gave rise to symptoms of glaucoma at such an early stage of its pathology.

W. ZENTMAYER.

THE ROUTES OF EXTRA-OCULAR EXTENSION OF MELANOSARCOMA OF THE CHOROID. G. DURANTI, Ann. di ottal. e clin. med. **58:** 134 (Feb.) 1930.

The author reports careful histologic studies in the case of a woman, aged 38, whose eye was enucleated for melanosarcoma. A dark area, 0.2 by 1 mm., was seen in the sclera near the optic nerve. Extension of the densely pigmented tumor surrounding one of the ciliary nerves was accompanied by a small artery. A number of pigmented cells seen in the sclera at the site of the tumor and elsewhere were considered as previously present and independent of the tumor. Sections of a normal eye showed the tendency of pigmented cells from the choroid to develop around the ciliary nerves. The author does not give the further course of the case as to the development of local recurrence. Evisceration of the orbit was evidently not performed, in spite of the histologic report.

S. R. GIFFORD.

THE PROGNOSIS IN ENUCLEATION FOR MELANOSARCOMA OF THE UVEA. P. A. JAENSCH, Klin. Monatsbl. f. Augenh. **84:** 649 (May) 1930.

The author refers to Waetzold's request of an exenteration of the orbit in any case in which the presence of a melanosarcoma of the choroid has been diagnosed as probable. Jaensch reports the result of the histologic examination of sixty-eight cases observed at Bielschowsky's clinic at Breslau. They include nine cases of sarcoma of the iris and ciliary body. The choroidal tumors had grown into the sclera in thirteen cases and had perforated it in twelve; the orbit was totally filled with tumor masses in five cases. Contrary to Waetzold's postulate, the author, notwithstanding his own statistics, adheres to the enucleation of eyes with a uveal sarcoma. In his opinion, exenteration is not necessary as long as the tumor is strictly intra-ocular, or has grown into the sclera without visible perforation. Exenteration is suggested to the patient only when a perforation has been found histologically; it is done in all cases in which a perforation is recognized prior or during the operation. Posterior sclerotomy, iridectomy in cases complicated by glaucoma or trial punctures for diagnostic purposes should not be done

prior to the enucleation, although they have been performed without loss of life to a number of patients who did not suffer from metastases later.

K. L. STOLL.

ORIGIN OF MALIGNANT MELANOMA OF TUNICA CONJUNCTIVA. O. HEINONEN, Finska läk. handl. **72**: 261 (April) 1930.

In Heinonen's case of malignant melanotic tumor localized in the tarsal conjunctiva of the upper eyelid, extirpation was followed by several recurrences, partly in the same place, partly free pigmented tumors of the conjunctiva. Microscopic examination of one of the tumors, which had been macroscopically visible for only two weeks and rapidly increased in size, seemed to indicate changes of an epithelial nature. In the peripheral, more recent portions of the tumor there was chiefly epithelial proliferation; in the central, older portions, pathologic degeneration of the cells that had undergone proliferation. These cells bore a marked resemblance to the tumor cells of the primary tumor.

[J. A. M. A.]

Visual Tracts and Fields

LESIONS OF THE CHIASMAL REGION. C. B. WALKER, Am. J. Ophth. **13**: 198 (March) 1930.

The author reviews the anatomy of the chiasm. He takes up aneurysms, primary gliomas of the chiasm, craniopharyngeal pouch tumors, suprasellar tumors, meningiomas and orbito-ethmoidal osteoma. He also describes the various pituitary diseases. This article does not lend itself to abstracting.

W. S. REESE.

THE FIELDS OF VISION IN MINERS' NYSTAGMUS. C. F. HAYCRAFT, Brit. J. Ophth. **14**: 523 (Oct.) 1930.

From the study of the fields of vision in a series of forty-three cases of miners' nystagmus, of which thirty-five were old and eight were new cases (that is, certified as suffering from the disease within the previous six months), the author arrives at the following conclusions:

In a large percentage of cases of miners' nystagmus there is a definite alteration in the fields of vision. The most common change is a concentric contraction for white. A large number of patients show contraction for red and blue, and interlacing of these colors is frequent. The amount of contraction of the fields is usually but not invariably a measure of the severity of the disease. In the absence of physical signs, the change in the fields described, combined with typical subjective symptoms, can be relied on in diagnosing miners' nystagmus or in determining that recovery is still insufficient to permit work underground.

W. ZENTMAYER.

Therapeutics

INSULIN THERAPY IN OCULAR DISEASES. C. GIUSEPPE, Ann. di ottal. e clin. med. **58**: 68 (Jan.); 146 (Feb.) 1930.

The author reports a number of cases, chiefly in patients with diabetes, in which insulin was used. These included: nine cases of cataract, one of iridocyclitis, one of iridocyclitis with glaucoma, four

of glaucoma, one of paralysis of the external recti, one of choroiditis and nine of retinitis. In the cases of cataract the use of insulin reduced the blood sugar to normal, and operation was performed without complications. In one case in which the urine was normal a postoperative iridocyclitis occurred and the blood sugar was found to be high. The reaction subsided when treatment with insulin was begun. In the cases of iridocyclitis, no effect of the insulin was noted. In the cases of glaucoma, a slight increase in tension was noted after the first few injections, but this soon dropped to the previous figures. In two cases of glaucoma complicated by retinal hemorrhages, the hemorrhage cleared up under treatment with insulin, while the tension remained the same. The cases of retinitis were uninfluenced by treatment. The unusual case of bilateral abducens paresis cleared up rapidly under treatment with insulin. In the case of myopia and choroiditis there was considerable improvement in vision, which was subsequently reduced by opacities of the lens. The opacities developed during treatment with insulin, and hence were apparently independent of the diabetes. In other cases of incipient cataract the opacities of the lens progressed in spite of treatment.

The author concludes that in diabetic patients insulin is indicated as a preliminary to operations for cataract, progressive myopia and in paralysis of the ocular muscles, including those of accommodation. It is not contraindicated in glaucoma, but apparently has no effect on retinitis or iridocyclitis.

S. R. GIFFORD.

VACCINOTHERAPY IN OPHTHALMIA NEONATORUM. L. MAMOLI, Saggi di oftal. **5**: 417, 1930.

Thirty-one patients were treated with four kinds of gonococcal vaccines, some also containing other organisms. Details of eight especially severe cases, in which the cornea was involved before treatment, or which were not influenced by other treatment, are given; in the other cases an uneventful course was observed. Only the patients showing a febrile reaction seemed to benefit by the vaccine. In one case a corneal ulcer developed in spite of the vaccine, which caused no febrile reaction, but improvement occurred after the administration of a nonspecific protein, which produced fever. In other cases, large doses, 100,000,000 organisms or more, were necessary to produce the desired effect. The author believes that the use of specific vaccines has the advantage over nonspecific protein therapy in producing not only a first nonspecific reaction but also an active immunity which develops several days after the first injection.

S. R. GIFFORD.

Society Transactions

EDITED BY DR. GEORGE S. DERBY

ROYAL SOCIETY OF MEDICINE, LONDON (ENGLAND), SECTION OF OPHTHALMOLOGY

H. DICKINSON, M.D., *Reporter*

Oct. 10, 1930

ELMORE BREWERTON, F.R.C.S., *President, in the Chair*

Mr. Brewerton referred sympathetically to the death of Mr. A. L. Whitehead, of Leeds, a former president of the Section. Mr. Ernest Clarke paid a warm tribute to his memory.

A CASE OF KERATITIS. MR. ADRIAN CADDY.

In a woman, aged 63, a nodule developed on the inner side of the eye. There was an infiltration of the vessels coming from the sclerotica, but no acute inflammatory change. There had not been any corneal ulceration or any evidence of breach of surface. The Wassermann reaction was negative and the Pirquet test positive. There seemed to be no abnormality about the fundus. Treatment had been chiefly symptomatic. It appeared to be a degenerative condition of the cornea, of a calcareous nature.

TRAUMATIC ZONULAR CATARACT. MR. FRANK LAW.

A girl, aged 14, had complained of defective vision in the left eye for two years. Four years before presentation she was struck in the eye by a twig. The right eye was emmetropic, but otherwise normal, except for fairly well marked vitreous bands. The condition was first thought to be congenital lamellar cataract, but the pattern usually seen in that condition was absent.

LOCAL ABSENCE OF THE STROMA OF THE IRIS. MR. FRANK LAW.

A boy, aged 12, had always had a black spot in the eye, but no subjective symptoms or other abnormality. With weak myopic correction, vision was 6/5 in both eyes. There was no apparent lackof musculature of the iris. There was, the exhibitor thought, a normal development of the eye so far as the ectoderm was concerned, but locally the mesoderm had lagged behind.

RETINAL PIGMENTATION. MR. FRANK LAW.

A boy, aged 5, was examined for refraction. All the other members of his family had normal fundi. There was a scattered guttate pigmentation over the whole of both fundi. A Wassermann test had not been made.

EARLY DIABETIC RETINITIS. MR. DOGGART.

A woman, aged 47, had had the disease more than two years. Last April left-sided herpes ophthalmia, complicated by iritis, developed. The fundi were normal. Since the beginning of the attack she had been using atropine in the left eye. She also had coronary cataract in each eye, and the fundi were arteriosclerotic. At each macula there were multiple minute exudates and punctate hemorrhages.

MULTIPLE FOREIGN BODIES IN THE CORNEA. MR. DOGGART.

A woman, aged 27, said that for two years her eyes had been misty occasionally, and that for six months previously they had been irritable. Her work was in a cracker factory. Sometimes, owing to heat, a discharge of powder would occur into her face. Examination of the cornea disclosed many minute foreign bodies, some whitish and others brownish, in the epithelium and the layers of the substantia propria. The best vision in each eye was 6/18. Six months later she had become tolerant to the presence of these foreign bodies.

RODENT ULCER EXTENDING INTO THE ORBIT. MR. E. WOLFF.

A man was first seen in June, 1928, when he had an ulcer in the right eye, near the inner canthus. This was treated by means of a surface application of radium for four months. The skin healed, but the growth extended back, involved the conjunctiva and proceeded to invade the orbit. Mr. Wolff then excised the growth extensively, but after a few months it recurred. In July, 1929, he inserted 4 mg. needles of radium into the growth, placing one of them deeply along the lateral wall of the ethmoid. Fifteen months later there seemed to be an entire freedom from growth. It is usually held that when once a rodent ulcer has invaded the conjunctiva, there is little chance of saving the eye. In cases of ulcer near the canthus it is important to apply the radium to the ethmoid.

DISCUSSION

MR. BREWERTON: Members should keep in touch with patients whom they send for radium treatment. One of my patients was told that he was improving during the applications, whereas at a later stage the orbit had to be exenterated, though originally the growth was only the diameter of the little finger.

MR. HARRISON BUTLER: I had a case in which a growth of a similar nature was confined to the conjunctiva of the lower lid. That patient had one application of radium at the Radium Institute, and the condition was completely cleared up.

MASSIVE EXUDATE. MR. J. F. CUNNINGHAM.

A girl, aged 19, came to the hospital four months before presentation with a large slate-gray mass, the edge of which had become crenated since she came under observation.

CONTACT GLASSES FOR HIGH ASTIGMATISM. MR. J. H. BEAUMONT.

A salesman had astigmatism amounting to 18 diopters. Because of inability to read when fitted with the indicated cylinders, contact glasses

were made, under which neither the ophthalmometer nor retinoscopy could detect any astigmatism.

ENTOPTIC PHENOMENA. MR. BREWERTON.

I chose this subject because of its fascination, as one can see most of the phenomena in one's own eyes. Patients often ask for an explanation of the phenomena due to shadows thrown on the retina, and the ophthalmologist not only should be familiar with them, but should explain them to his students. The term means subjective impressions of objects within the eyeball. Shadows were thrown on the retina by objects in the transparent media of the eye of a different refractive index than that of the medium in which they lay. In order to cast shadows the objects must be opaque; if they were not opaque, those with a higher refractive index would appear luminous with a dark border, and those with a lower index than the medium in which they lay would have a dark center and luminous edges. Before the advent of the ophthalmoscope they were considered to be of great importance.

Methods of demonstrating the shadows include looking at the bright sky, at the illuminated field of a microscope, at a bright reflected bead of light, at an artificial light with the lids nearly closed and at the sky or a light through a minute pin-hole. Retinal vessels throw shadows if a light enters the eye through the sclerotica. The shadows coming from the cornea are not really entoptic, as they do not originate in the eyeball. I shall deal with those later.

The shadows from the lens are best seen by looking at a light through a hole 0.1 mm. in diameter. The apparent size of the illuminated area seen depends on the size of the observer's pupil. The edge of the illuminated area shows innumerable bright projections extending outward for a short distance, but these are seen only if the hole is sufficiently minute; probably they are an optical effect, and have nothing to do with the eye. In this illuminated area clearcut details can be seen. Any dots or striae in the lens, if they invade the pupillary area, appear dark but transparent; congenital dots and the physiologic lens sector lines appear bright with dark borders, as their refractive indexes are higher than that of the rest of the lens.

Most of one's trouble with patients complaining of entoptic shadows arises from shadows thrown by strands in the vitreous. It is surprising how little noticed are gross opacities of the vitreous. They cause blurred vision which comes and goes, but the opacities are not focused as sharply defined strands, whereas the so-called muscae volitantes appear as bright-beaded, curly bands, dark against the sky and transparent against a bright light. These can be demonstrated by looking at a bright light with the lids nearly closed.

With regard to the retina, in a darkened room light focused on the sclerotica shows an inverted picture of the retinal vessels. The eye must be turned toward the nose and the light focused on the outer side; a slight continuous up-and-down movement should be given to the light. The vessels are seen clearly, but only in the macular region and for about 2 disk diameters around the fovea. The disk itself is just out of focus. The vessels appear as dark branching streaks on a red field. It is impossible to differentiate between arteries and veins. The fovea

and the vessels near it form a brilliant picture. I believe that the vessels surrounding the fovea can be traced more easily and accurately subjectively than by an ophthalmoscope.

Theoretically, the entoptic appearance of the macular region should be of value in an observant patient in determining early and advancing macular changes. After an upward iridectomy many patients complain of lines of light radiating downward from any bright light. This is due to the moist margin of the upper lid bending some of the rays upward through the coloboma; a patient with ptosis suffers in a similar manner. Colored rings usually originate from the cornea; they may be transient and due to mucus on the surface of the cornea, though in rare cases they may be permanent. They are always present in glaucoma if the cornea is hazy. Some persons see faint colored rings whenever they look at a light. I think that the hazy cornea is due to tension of the fibers of the stroma, producing minute separations between adjacent fibers and acting like a diffraction grating. The haze instantly disappears when the pressure is reduced.

My reason for bringing this subject forward is that as instruments for examining the eye become more elaborate, there is apt to be a neglect of simple methods. An intelligent patient, aware that he is suffering from early cataract and undergoing treatment intended to cause absorption of the opacities, can make a careful monthly drawing of what he sees and can note any change taking place.

THE DETECTION OF COLOR BLINDNESS FROM A PRACTICAL POINT OF VIEW. MR. F. W. EDRIDGE-GREEN.

The two essentials of a practical test for color blindness are that only dangerously color-blind persons should be rejected by it, and that no dangerously color-blind person should escape detection. The wool test with five test colors allows 50 per cent of the dangerously color-blind to escape detection; of those rejected by it, 50 per cent have practically normal sight. Most of the other tests for color vision are as defective as this or worse.

The three most dangerous groups of color-blind persons are the dichromic (who see two colors in the spectrum), the trichromic (who see three colors in it and have no yellow sensation) and those who have considerable shortening of the red end of the spectrum. An examination of one of each of these groups will show definitely the value of names for colors. A dichromic regards a certain green as white and a corresponding purple also as white. When shown these colors, why should he call them anything except the white which he sees? If the green is made yellower he will immediately call it green. Those with shortening of the red end of the spectrum may be shown a red light which they do not see at all, and say so; they may be shown a pink which appears a definite blue to them, as it does to a person with normal sight when he examines it through a bluish-green glass. Color-blind people name colors in accordance with their perception of color.

The pseudo-isochromatic tests in common use are those of Stilling and Ishihara and my card test. In order to ascertain the relative merits of these three tests, fifty consecutive, referred or appeal, cases were examined at the Board of Trade, with the following results. Each can-

didate was first examined by the pseudo-isochromatic tests and the fact whether he was dangerously color-blind or not was ascertained subsequently. Seventeen of the fifty persons were passed and thirty-three rejected. Of the thirty-three who failed, nineteen failed with all three pseudo-isochromatic tests, but fourteen of those rejected passed the Ishihara test completely, and thirteen passed the Stilling test. Of those who failed, all were rejected by my card test.

Nagel's anomaloscope is not a satisfactory test, as a person may have anomalous perception without being color-blind, and as 90 per cent of the color-blind show agreement with the normal equation.

A short discussion followed.

Book Reviews

KURZES HANDBUCH DER OPHTHALMOLOGIE. By PROF. F. SCHIECK, Würzburg, and PROF. A. BRÜCKNER, Bale. Volume III. Price, 142 marks. Pp. 745, with 454 illustrations. Berlin: Julius Springer, 1930.

This volume contains chapters on: (1) Diseases of the Orbit, by Prof. A. Birch-Hirschfeld, Königsberg; (2) Diseases of the Nasal Accessory Sinuses, by Prof. A. Linck, Greifswald; (3) Diseases of the Lids, by Professor Löhlein, Jena; (4) Diseases of the Lacrimal Organs, by Prof. W. Meissner, Greifswald; (5) Ocular Movements, by Prof. R. Cords, Cologne; (6) Motor Anomalies, by Prof. R. Cords, Cologne; (7) The Relation of the Eye to the Ear, by Prof. M. Bartels, Dartmund.

A glance at this table of contents shows how well the authors of the Handbuch have selected their collaborators, as each one is noted as a specialist in his peculiar field.

Birch-Hirschfeld, who wrote the monumental elaboration of orbital diseases in the large Handbuch of Graefe-Saemisch, has endeavored to bring out everything of practical importance in this subject, and has added the recent bibliography. The subject is treated in 136 pages. After an excellent anatomic introduction, circulatory disturbances of the orbit are described, which include congestive edema and intermittent and pulsating exophthalmos. The other chapters take up hemorrhage of the orbit, inflammations which comprise edema, periostitis, abscess, syphilis, tuberculosis and several unusual conditions like actinomycosis, anthrax and tetanus, parasites, tumors and injuries.

Professor Linck, a rhinologist, was selected because of the close relation of this subject to ophthalmology. He discusses the inflammations of the nasal accessory cavities and their complications, the specific infections, inflammatory granulomas, tumors and injuries. The complications include orbital perforations, retrobulbar neuritis explained by the investigations of Herzog, de Kleijn and Gerlach, Birch-Hirschfeld and Gradle, and involvement of the ocular muscles. As for the much discussed relation of retrobulbar neuritis and sinus disease, the author says that at present there is no reliable way to differentiate a rhinogenic optic neuritis from a nonrhinogenic one, and as a negative clinical picture does not exclude a latent sinusitis, an exploratory operation is indicated provided there is no other probable cause either neurologic or ophthalmologic.

The diseases of the lids are treated by that excellent clinician, Professor Löhlein, in 123 pages, with many illustrations. Professor Meissner gives a complete description of disturbances of the lacrimal organs, in 73 pages, and a critical résumé of the present fistulizing operations on the nose.

The subject of the physiology of the ocular movements and of the motor anomalies, by Professor Cords, is covered in 200 pages. It is taken up under the following headings: mechanics of ocular movements,

laws of ocular movements, fusion, position of rest of the eyes, tone of the ocular muscles, convergence, ocular movements and methods for their study. The pathologic ocular movements are considered under squint or paralysis, heterophoria, convergence insufficiency, squint or strabismus, dissociated ocular movements, paralysis of external ocular muscles, myasthenia, diseases of the ocular muscles, retraction movements, supranuclear disturbances of the ocular movements, disturbances of movements of the lids and nystagmus.

The relations of ocular movements to the internal ear are treated by Prof. H. Bartels, the well known writer and investigator in this obscure field. After giving the anatomy of the labyrinth, he describes, under the heading of physiology, labyrinthine ophthalmostatics and ophthalmokinetics, reflex paths and labyrinthine irritative nystagmus. The next part deals with the pathology of the ear and movements of the eyes, reflexes from the ear to the eye and vice versa; in the appendix, the reciprocal action of auditory and visual sensations and diseases of the eye and optic nerve associated with diseases of the ear are given.

The volume contains a vast amount of information that should be of great help to the practicing ophthalmologist. The selection and reproduction of the illustrations are admirable. It is a fitting successor to volumes I and V, which have already appeared.

A. K.

BIOMICROSCOPIE DU CRISTALLIN. By PROF. C. DUVERGER, Limoges, and PROF. E. VELTER, Paris. Price, 125 francs. Pp. 108, with 36 plates in color. Paris: Masson & Cie, 1930.

This slit-lamp study of the lens is a continuation of a similar volume on the cornea by Gallemaerts, of Bruxelles, in 1926, and of one on the anterior chamber, iris and ciliary body, by Mawas, of Paris, in 1928.

In addition to the biomicroscopic picture, the aspect on oblique and transmitted illumination is given, in many cases with a clinical description and the visual acuity. After describing the methods of illumination, the technic and the optical conditions found in the biomicroscopic examination of the lens, the authors take up in turn the normal lens, embryonal rests, congenital cataract, adult lenticular opacities, senile changes in the lens, senile cataract, pathologic cataracts (choroidal changes, diabetes, myatonia, dystrophy, tetany, endocrine and toxic changes), traumatic cataract, secondary cataract and zonule. They conclude that the biomicroscopic study of the lens permits more precise information and a valuable confirmation of important clinical observations without creating a new pathology. The old pictures are presented in a new light, enriched with new details, some descriptions are completed, and the prognostic significance of certain signs is better understood; at the same time it is essential not to neglect comparison with other methods of examination. A bibliography is appended. A most important and instructive part of the volume includes the illustrations, which are in color and are works of art.

A. K.

Directory of Ophthalmologic Societies *

FOREIGN

Oxford Ophthalmological Congress

Master: Dr. A. B. Cridland, Salisbury House, Chapel Ash, Wolverhampton, England.
Secretary: Dr. C. G. Russ-Wood, 12 St. John's Hill, Shrewsbury, England.

NATIONAL

American Medical Association, Section on Ophthalmology

Chairman: Dr. George F. Suker, 25 E. Washington St., Chicago.
Secretary: Dr. William C. Finnoff, Imperial Bldg., Denver.
Place: Philadelphia. Time: June 8-12, 1931.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. William H. Wilder, 122 S. Michigan Ave., Chicago.
President-Elect: Dr. J. F. Barnhill, Miami Beach, Fla.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: French Lick, Indiana. Time: Sept. 14-19, 1931.

American Ophthalmological Society

President: Dr. Arnold Knapp, 10 E. 54th St., New York.
Secretary: Dr. Emory Hill, Professional Bldg., Richmond, Va.
Place: Asheville, N. C. Time: June, 1931.

SECTIONAL

New England Ophthalmological Society

President: Dr. S. Judd Beach, 704 Congress St., Portland, Me.
Secretary-Treasurer: Dr. E. B. Dunphy, 520 Commonwealth Ave., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Chester H. Bowers, 1136 W. 6th St., Los Angeles.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, Medical-Dental Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Fletcher D. Woodward, Box 162, University, Va.
Secretary: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Place: New Orleans. Time: November, 1931.

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* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

Southwestern Michigan Triological Society

President: Dr. Wilfrid Haughey, 65 W. Michigan Ave., Battle Creek.
Secretary: Dr. R. H. Fraser, Battle Creek Sanitarium, Battle Creek.
Time: Third Thursday of alternate months.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Donald H. O'Rourke, 217 Imperial Bldg., Denver.
Place: First floor, Metropolitan Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. Dorland Smith, 836 Myrtle Ave., Bridgeport.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.
Time: May, November.

Eye, Ear, Nose and Throat Club of Georgia

President: W. L. McDougall, 50 Whitehall St., S. W., Atlanta.
Secretary-Treasurer: Dr. William O. Martin, Jr., 412 Medical Arts, Bldg., Atlanta.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. John W. Carmack, 23 E. Ohio St., Indianapolis.
Secretary: Dr. J. Kent Leasure, 23 E. Ohio St., Indianapolis.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. John C. Brown, 350 St. Peter St., St. Paul.
Secretary-Treasurer: Dr. Hendrie W. Grant, Lowry Bldg., St. Paul.

Montana Academy of Oto-Ophthalmology

President: Dr. Lee W. Smith, 125 W. Granite St., Butte.
Secretary: Dr. J. G. Parsons, Lewistown.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. B. Beeson, 232 W. De Mers Ave., Grand Forks.
Secretary-Treasurer: Dr. F. L. Wicks, Valley City.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. W. McCollom, 346½ Washington St., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

President: Dr. Raymond F. Hacking, 105 Waterman St., Providence.
Secretary: Dr. Herman A. Winkler, 224 Thayer St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

Utah Ophthalmological Society

President: Dr. Franklin H. Raley, 9 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. H. Leroy Smith, 1005 Medical Arts Bldg., Salt Lake City.

Virginia Society of Oto-Laryngology and Ophthalmology

Secretary-Treasurer: Dr. Henry Grant Preston, Harrisonburg.
President: Dr. Fletcher D. Woodward, Box 162, University.

West Virginia State Medical Association, Eye, Ear, Nose and Throat Section

President: Dr. S. S. Hall, Fairmont.
Secretary: Dr. G. A. Smith, Montgomery.
Place: Clarksburg. Time: 1931.

LOCAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. J. Wallace Hurff, 86 Washington St., Newark.
Secretary: Dr. Earl LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

Academy of Medicine of Toronto, Section of Ophthalmology

Chairman: Dr. Louis Joseph Sebert, 86 Bloor St., W., Toronto.
Secretary: Dr. Alexander E. MacDonald, 151 Bloor St., W., Toronto.
Time: First Monday of winter months.

Atlanta Academy of Ophthalmology and Oto-Laryngology

President: Dr. William L. McDougall, Atlantic National Bank Bldg., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St., N. E. Time: 8 p. m., last Thursday of each month.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. Angus Lloyd MacLean, Johns Hopkins Hospital, Baltimore.
Secretary: Dr. Henry F. Graff, 513 N. Charles St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. John N. Evans, 23 Schermerhorn St., Brooklyn.
Secretary: Dr. Michael J. Buonaguro, 589 Lorimer St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday of February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. A. F. Luhr, 40 W. North Ave., Buffalo.
Secretary-Treasurer: Dr. Thurber Le-Win, 112 Linwood Ave., Buffalo.

Chicago Ophthalmological Society

President: Dr. Harry S. Gradle, 58 E. Washington St., Chicago.
Secretary: Dr. Richard C. Gamble, 30 N. Michigan Ave., Chicago.
Place: Medical and Dental Arts Club. Time: Third Monday from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. William V. Mullin, 9204 Euclid Ave., Cleveland.
Secretary: Dr. H. C. Rosenberger, 2064 E. 9th St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. W. E. Burner, Guardian Bldg., Cleveland.
Secretary: Dr. M. P. Motto, Rose Bldg., Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. Maxwell Langdon, 1530 Locust St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Otolaryngological Society

Chairman: Dr. A. M. Hauer, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. Albert D. Frost, 681 E. Broad St., Columbus, Ohio.
Time: First Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. B. Decherd, 1717 Pacific Ave., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, 1717 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Parker Heath, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. G. G. Marshall, 122 West St., Rutland, Vt.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. J. J. Richardson, 606 Penn St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, 1304 Medical Arts Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. Claude C. Cody, 1306 Walker Ave., Houston, Texas.
Secretary: Dr. J. M. Robison, Eye, Ear, Nose and Throat Hospital, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

Indianapolis Ophthalmological and Oto-Laryngological Society

President: Dr. E. L. Lingeman, 241 N. Pennsylvania St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Otolaryngology

President: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Secretary: Dr. O. S. Gilliland, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

President: Dr. Dean E. Godwin, Security Bldg., Long Beach, Calif.
Secretary-Treasurer: Dr. Ferris Arnold, Security Bldg., Long Beach, Calif.
Place: Pacific Coast Club. Time: Last Wednesday of each month from September to June.

Los Angeles County Medical Society, Section on Ophthalmology and Otolaryngology

President: Dr. A. Ray Irvine, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 727 W. 7th St., Los Angeles.
Place: California Lutheran Hospital, Assembly Room. Time: 8 p. m., first Monday of each month.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. James A. Flynn, 1511 Rhode Island Ave., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month.

Memphis Society of Ophthalmology and Oto-Laryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

President: Dr. Edward R. Ryan, 425 E. Water St., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 120 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. R. J. Warner, 706 Church St., Nashville, Tenn.
Secretary-Treasurer: Dr. W. W. Wilkerson, Jr., Bennie-Dillon Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

New Orleans Ophthalmological and Otological Society

President: Dr. W. R. Buffington, 211 Camp St., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. E. F. Krug, 12 W. 44th St., New York.
Secretary: Dr. William F. C. Steinbugler, 815 Park Ave., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Otolaryngological Society

President: Dr. George B. Potter, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 425 Aquila Court, Omaha.
Place: Medical Tea Room. Time: 5:15 and 7:00 p. m., third Wednesday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. A. Vincent Walker, 833 South Ave., Rochester, N. Y.
Secretary-Treasurer: Dr. John F. Gipner, 53 Fitzhugh St., Rochester, N. Y.
Place: Rochester Medical Assn., 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Charles W. Tooker, 308 N. 6th St., St. Louis.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: St. Louis or Washington University Cafeteria.
Time: 6:30 p. m., fourth Friday of each month from October to April, inclusive.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. F. W. Sorrell, Gibbs Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. A. F. Clark, 728 Main Ave., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

Spokane Academy of Ophthalmology and Otolaryngology

President: Dr. A. N. Codd, 421 W. Riverside Ave., Spokane, Wash.
Secretary: Dr. Marc Anthony, Old National Bank Bldg., Spokane, Wash.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Sigurd von Christierson, 11 W. Portal Ave., San Francisco.
Secretary: Dr. Wilber F. Swett, 693 Sutter St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Third Tuesday of every month except May, June, July and December.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. Searle B. Marlow, State Tower Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubenstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.